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PART III—ABSTRACTS

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49TH INDIAN SCIENCE CONGRESS, CUTTACK, 1962

SECTION OF MATHEMATICS

PRESIDENT Dr. P. L. BHATNAGAR, M. Sc., D.Phil., D.Sc., F.N.I.

Abstracts

Theory of Numbers

1. On Some Properties of Partition

V. V. SUBRAHMANYA SASTRI, Tirupathi

The generating functions of $p\ (2n+l)$, $q\ (2n+l)$, $l = 0,\ 1$ are found in terms of $f(x) = \prod_{n=1}^{\alpha} (l-x^n) = \sum_{n=-\infty}^{n=\infty} (-1)^n\ x^{n/2}\,(3n+1)$, $p(n)$, $q(n)$ being the number of partitions of n into unrestricted and unequal parts respectively. Incidentally, some relations between $\sum_{n=0}^{\infty} p(2n)\,x^{2n}$, $\sum_{n=0}^{\infty} p(2n+1)\ x^{2n+1}$, $\sum_{n=0}^{\infty} q(2n)\,x^{2n}$, $\sum_{n=0}^{\infty} q(2n+1)\ x^{2n+1}$ and $f(x)$ have been proved.

Next, the generating functions of $q(3n+l)$, $l = 0,1,2$ are found in the terms of $f(x)$ and $\psi_l\,(x) = w^{l-1}\,f(wx)\ f(wx^2)+w^{2(l-1)} \times f(w^2\ x)\times f(w^2x^2)$, w being an imaginary cube root of unity and $\psi_l(x)$ are expressed in terms of $\phi_1(x) = w^{l-1}\ \times f(wx)+w^{2(l-1)}$ $f(w^2x)$. Further some incidental relations between $\Sigma\ q(3n)x^{3n}$, $\Sigma\ q(3n+1)x^{3n+1}$, $\Sigma q(3n+2)x^{3n+2}$ $f(x)$ and $\psi_l(x)$ have been proved.

Modern Algebra

2. Bounded Linear Operators in a Hilbert Space

S. K. SINGH, Dharwar

In this paper the algebraic structure of bounded linear operators are studied. Let H be a Hilbert space and let β be the set of all bounded linear operators defined on H into H. Then it is easy to verify that β forms a ring with identity under usual addition and multiplication of operators. Let α be a subset of β, define

$$\alpha_1 \ = \{\ T\ \varepsilon\ \beta : TS = ST \text{ for every } S\ \varepsilon\ \alpha\}$$

$$\alpha_k \ = \{\ T\ \varepsilon\ \beta : TS = ST \text{ for every } S\ \varepsilon\ \alpha_{k-1}\}$$

$$k \geqslant 1.$$

α will be called a commutative subset of β if $T_1\ T_2 = T_2\ T_1$ for every pair T_1, $T_2\ \ \varepsilon\ \alpha$; and α will be called a Hermitian subset of β if all the operators in α are

Hermitian (that is, when $T^* = T$ for every $T \varepsilon \alpha$ where T^* is the adjoint operator of T).

We prove the following theorems :

Theorem 1 (a) $\alpha_1 = \alpha_3$ for every $\alpha \subset \beta$

(b) $\alpha = \alpha_2$ if and only if $\alpha = r_1$ for some $r \subset \beta$

(c) α_1 is a subring of β.

Theorem 2(a) Let $\alpha \subset \beta$ then α is a commutative subset of β if and only $\alpha \subset \alpha_1$

(b) β is a commutative ring if and only if $\beta = \beta_1$.

Theorem 3 : If α is a Hermitian and commutative subset of β then α is a commutative subring of β.

Theorem 4 : If β is a division ring then β_1 is a field.

Theorem 5 : β will form a division ring if and only if

(i) there exists a positive number c such that $\| Th \| \geqslant c \| h \|$ for every vector $h \varepsilon H$ and every $T \varepsilon \beta$ and when

(ii) $\overline{T(H)} = H$.

where the closure is taken in the norm topology.

Set Theory

3. On Certain Property of Sets with Positive Measure

A. K. Mookhopadhyay, Calcutta and B. K. Lahiri, Burdwan

In this paper we prove the following theorem : If C be a closed set of positive measure contained in the open unit sphere in E_n (n-dimensional Euclidean space) and $\lambda_1, \lambda_2, \ldots \lambda_p$ be any p real numbers satisfying

$$1-\delta < \lambda_i \leqslant 1, \; i = 1, 2, \ldots\ldots p \, ;$$

δ (>0) depending on p,n and the measure of C, then the set of points ξ of C such that

$$\frac{\xi}{\lambda_i} \varepsilon C, \quad i = 1,2,\ldots,p$$

form a closed set of positive measure.

A result of the similar kind has been proved earlier by one of the authors (Lahiri, B. K. (1959), Bull. Cal. Math. Soc., 51), restricting the numbers $\lambda_1, \lambda_2, \ldots \lambda_p$ to range in some suitable right neighbourhood [one sided closed] of 1.

4. On the Construction of Some SD-sets

N. C. Bose Majumder, Calcutta

This author has shown (1960) that Cantor set C is, an SD-set (called here, 'δ' property) [i.e., a set E whose distance set fills an interval about origin, of length = diameter of E], a symmetric set (called here, 'δ' property) [i.e., there is a point $y \varepsilon E$ corresponding to any given point $x \varepsilon E$, such that $x+y = a+b$, where E $[a,b]$

and $a \varepsilon E$, $b \varepsilon E$], and has the property (called here, 'μ' property), that each point of the interval in which E is defined, is midway between a pair of points of E.

We have shown (1960), that (i) if a set E possesses σ and μ, it must possess δ: (ii) if E possesses σ and δ, it must possess μ. We now show that (iii) if E possesses μ and δ, it does not necessarily possess σ.

Moreover, we have constructed here a family of symmetric sets and tested them by the above theorems (i and ii) for *SD*-sets. We have shown in this paper that the set E of points, whose decimals in the scale r ($= 2l-1, l \geq 2$), miss the digit l, or miss the digits $(l-1, l, l+1)$ or miss the digits $(l-2, l-1, l, l+1, l+2)$, and so on, is symmetric and may be an *SD*-set; also the set E of points whose decimals in the scale r ($= 2l, l \geq 2$), miss the digits $(l-1, l)$ or miss the digits $(l-2, l-1, l, l+1)$, and so on, is symmetric and may be an *SD*-set. A family of non-symmetric *SD*-sets has also been considered in this paper.

Functions of Complex Variables

5. A Note on a Theorem of Fabry

S. K. Singh, Dharwar

Theorem : Let $f(z) = \sum_{n=0}^{\infty} a_n z^n$ be a power series whose radius of convergence is unity. If $\lim_{n \to \infty} \frac{a_n}{a_{n+1}} = 1$, then $z = 1$ is a singular point of $f(z)$. The above is a well known theorem of Fabry (see 1, p. 377, Th. II]. The purpose of this note is to give an alternative simple proof of this theorem.

Special Functions

6. On the Bessel Polynomials

S. K. Chatterjea, Calcutta

In connection with certain solutions of the wave equation, Krall and Frink (Trans. Amer. Math. Soc., Vol. 55, 1949, pp. 100-115) considered a system of polynomials $y_n(x)$, known as the Bessel Polynomials. Recently Rajagopal (Amer. Math. Monthly, Vol. 67, 1960, pp. 166-169) has given an interesting representation for $y_n(x)$ in the iterative sense.

In this paper we present two determinant representations for $y_n(x)$, one is derived from the Rodrigues formula and the other from the recursion relation. These determinants have been studied in some details. A continued fraction-expression for $y_n(x)/y_{n-1}(x)$ is derived. Two determinant representations for the Laguerre polynomials $x^n L_n^{(-2n-1)}(2/x)$ are also given. Moreover some recursion relations of $y_n(x)$, which are supposed to be new, are obtained.

Integral Transforms

7. On Jacobi Transform

L. DEBNATH, Calcutta

The Jacobi Transform $f^{(\alpha,\beta)}(n)$ of $F(x)$ is introduced by means of the integral

$$f^{(\alpha,\beta)}(n) = J\ \{F(x)\} = \int_{-1}^{+1} (1-x)^{\alpha}(1+x)^{\beta}\, P_n^{(\alpha,\beta)}(x)\, F(x)dx$$

and the following theorems regarding operational properties of the transform have been established.

Theorem 1. If $F(x)$ and $F'(x)$ be bounded at $x = \pm 1$, $F''(x)$ be bounded and integrable in each of the interval $-1 < x < 1$, $J\ \{F(x)\}$ exists and

$$\operatorname*{Lt}_{x\to\pm1} (1-x)^{\alpha+1}(1+x)^{\beta+1}F(x) = \operatorname*{Lt}_{x\to\pm1} (1-x)^{\alpha+1}\ (1+x)^{\beta+1}\ F'(x) = 0$$

then $J\ \{R[F(x)]\}$ exists and $J\{R[F(x)]\} = -n(n+\alpha+\beta+1)\, f^{(\alpha,\beta)}(n)$ $(n=0,1,2,3,\ldots)$.

Theorem 2. If $F(x)$ be integrable in each of the sub-interval of $-1<x<1$ and $f^{(\alpha,\beta)}(o) = 0$ then $f^{(\alpha,\beta)}(n)$ exists and for each constant C

$$J^{-1}\left\{-\frac{f^{(\alpha,\beta)}(n)}{n(n+\alpha+\beta+1)}\right\} = R^{-1}[F(x)] = \int_0^x \frac{1}{(1-s)^{\alpha+1}\ (1+s)^{\beta+1}} \int_{-1}^{s} (1-t)^{\alpha}\,(1+t)^{\beta}\, F(t)dtds + C$$

(n being a positive integer)

A few recurrence relations for $f^{(\alpha,\beta)}(n)$ and the inverse transformation have been obtained. The Legendre transform of R. V. Churchill (Jour. of Math. & Physics (1954), 33, p. 165–78) and the Gegenbauer transform of S. D. Conte (Quart. Jour of Math. (1955) 6, p. 48) and their operational properties will come out as a particular case of this transform for special choice of α, β.

Finally, the transform has been utilised to solve the heat equation for one dimentional linear flow of heat in the medium $-1<x<1$. Considering a non-homogenous bar with its extremeties at $x = \pm 1$, whose lateral surface is insulated, the solution of the heat-equation

$$\frac{\partial}{\partial x}\left[\ [(1-x^2)\frac{\partial}{\partial x}\ U(x,t)\ \right] + \frac{\mu x+\nu}{\lambda}\,\frac{\partial}{\partial x}U(x,t) = \frac{\rho,c}{\lambda}\ \frac{\vartheta}{\partial t}\ U(x,t)$$

can be put in the form

$$U(x,t) = \sum_{n=0}^{\infty} (Sn)^{-1}\ g^{(\alpha,\beta)}(n)\ P_n^{(\alpha,\beta)}(x)\ e^{-n(n+\alpha+\beta+1)\ \frac{\lambda}{\rho.c}\ t}$$

8. An Application of Laguerre Transform on the Oscillation of a very long and Heavy Chain

L. DEBNATH, Calcutta

The Laguerre transform $f_{\alpha}(n)$ of $F(x)$ was introduced [Debnath (1960), Bull. Cal. Math. Soc. Vol. 52] by the integral

$$f_{\alpha}(n) = T\ \{F(x)\} = \int_0^{\infty} e^{-x}\, x^{\alpha}\, L_n^{\alpha}(x)\, F(x)dx$$

In this paper, this transform has been used to solve the partial differential equation governing the forced vibration of a very long and heavy chain of mass ρ per unit length, suspended from one end.

Taking the tension of the chain $T = g\rho x$ and the external transverse force actiug on the chain per unit length,

$$P(x,t) = g\rho(\alpha - x + 1)\frac{\partial Y}{\partial x}$$

the solution of the equation

$$x\frac{\partial^2 Y}{\partial x^2} + (\alpha - x + 1)\frac{\partial Y}{\partial x} = \frac{1}{g}\frac{\partial^2 Y}{\partial t^2}$$

where $Y(x,t)$ is the displacement function of the chain from its equilibrium-position, is of the form

$$Y(x,t) = \sum_{n=0}^{\infty}(Sn)^{-1}\,[y_\alpha\,(n,0)\,Ces\,(\sqrt{ng})\,t + y_\alpha{}^1\,(n,0)\,\sin\,(\sqrt{ng})t]\,L_n{}^\alpha\,(x)$$

Summability

9. On the Absolute Riesz Summability Factors of Infinite Series

G. D. Dikshit, Allahabad

1.1. Concerning absolute Riesz summability factors for general infinite series, the author has already published some results (Indian Journal of Mathematics, 1 (1958-59), pp. 33–40; Proc. Nat. Inst. Sci. India, 26A, (1960), pp. 86–94). In these papers, he has discussed the nature of summability factor-sequence $\{\varepsilon_n\}$ which should be such that whenever a series $\Sigma\,a_n$ is summable $|R, \lambda, \alpha|$, $\alpha \geqslant 0$, the factored series $\Sigma a_n\,\varepsilon_n$ may be summable $|R, \phi\,(\lambda), \alpha|$, where function $\phi(t)$ is a positive monotonic increasing function of t and has as many derivatives as one may require. While in the first paper he dealt with the integral order of summation, in the second he had proved a theorem for non-integral order of summation. In the latter one, he had made use of the fractional orders of derivatives of a function. Now he establishes the following theorem in which he does not make use of fractional order of derivatives.

1.2. Theorem. *Let $\phi\,(\omega)$ and $\psi\,(w)$ be the $(k+1)$-th indefinite integrals for $\omega \geqslant 0$, where k is the integral part of K (K being non-integral and positive), and let h be a finite positive number. If there exists a positive function $\gamma\,(w)$ such that*

$$\text{(i)}\quad \frac{\gamma(\omega)}{\omega} = 0(1),$$

$$\text{(ii)}\quad \left\{\begin{aligned} &\omega^n\psi^{(n)}(\omega) = 0\left[\left\{\frac{\gamma(\omega)}{\omega}\right\}^{K-n}\right],\ n = 1,2,\dots,k,\\ &\omega^{k+1}\psi^{(k+1}(\omega) = 0(1),\qquad \omega \geqslant h,\end{aligned}\right\}$$

$$\text{(iii)}\quad \{\gamma(\omega)^n\phi_{(}{}^{n)}(\omega) = 0\{\phi(\omega)\},\ n = 1,2,\dots,k+1;\ w \geqslant h,$$

and (iv) $$\left\{\frac{\gamma(\omega)}{\omega}\right\}^{K-k-1}\left\{1 - \frac{\phi(\omega)}{\phi(t)}\right\}^{K-r}\left\{\frac{\phi(\omega)}{\phi(t)}\right\}^{r}\ \varepsilon\beta\,Vt(,\omega\infty),$$

uniformly in $w \geqslant h$, $0 < r < k$,

and if with $x = t\sigma + (1-\sigma)u$, $f(t,x,u) = $ $$\left\{\frac{u}{\phi(t)}\right\}^{x}\left\{\frac{(t-x)}{\phi(t)-\phi(x)}\right\}^{k+1-x}\psi(x)\{\phi'(x)\}^{k+1}\varepsilon\beta\,V_t\,(u,\infty),$$

uniformly in $0 < \sigma < 1$ *and* $u > 0$, *then if the series* Σa_n *is summable* $|R, \lambda, K|$, *the series* $\Sigma a_n \psi(\lambda_n)$ *will be summable* $|R, \phi(\lambda), K|$.

10. Absolute Summability Factors of Infinite Series by Rieszian Means

Z. U. Ahmad, Allahabad

In the direction of the 'second theorem of consistency' for absolute Riesz summability, Prasad and Pati (Math. Annalen 140 (1960), pp. 187–197) have recently established two theorems, which are the refinements over a prior result of Guha (Jour. London Math. Soc. 31 (1956), 300-311). Very recently, Dikshit (Thesis (D.Phil), Allahabad University, 1960) has made an attempt to obtain an analogue of theorem 1 of Prasad and Pati (mentioned above) for the absolute Riesz summability factors of infinite series. The object of this paper is to obtain in the form of Theorems 1 and 2, direct analogues of the above mentioned result of Prasad and Pati for absolute Riesz summability factors and a further generalization of Dikshit's result. The theorems are :—

Theorem 1 : *Let* $\phi(t)$ *and* $\psi(t)$ *be defined in* $(0,\infty)$ *and be differentiable as many times as required. If* $\phi(t)$ *be a non-negative monotonic increasing function of t for* $t \geqslant 0$, *steadily tending to infinity as* $t \to \infty$, $\phi(t)$ *and* $\psi(t)$ *are the* $(k+1)$*-th indefinite integrals for* $t \geqslant 0$, *k being the integral part of K (assumed non-integral), there exists a positive function* $\gamma(t)$ *such that*

$$(\text{a}) \quad \left.\begin{array}{ll} \text{(i)} & \gamma(t)/(t) \varepsilon B(h,\infty), \\ \text{(ii)} & t^n \psi^{(n)}(t) = O\left[\left\{\dfrac{\gamma(t)}{t}\right\}^{K+1-n}\right], \; n = 0,1,\ldots,k+1, \; t \geqslant h, \\ \text{(iii)} & \{\gamma(t)\}^n \phi^{(n)}(t) = O\{\phi(t)\}, \; n = 1,2,\ldots,k+1, \; t \geqslant h, \end{array}\right\}$$

for some finite h, and, uniformly in $0 < v < 1$ *and* $s > 0$,

(b) $\Omega(s,v,t) \; \varepsilon \; BV_t(0,\infty)$,

then $|R,\lambda,K|$ *-summability of* Σa_n *implies* $|R, \phi(\lambda), \text{-}K|$*-summability of* $\Sigma a_n \psi(\lambda_n)$.

Theorem 2 : *If* $\phi(t), \psi(t)$ *and* $\gamma(t)$ *satisfy the same conditions as in theorem* 1, *with* (b) *replaced by :* (c) $\phi^{(1)}(t)$ *is monotonic non-decreasing,* $t \geqslant 0$, (d) $\psi(t)$ *is monotonic,* $t \geqslant 0$, *then* $|R, \lambda, K|$*-summability of* Σa_n *implies* $|R, \phi(\lambda), K|$*-summability of* $\Sigma a_n \psi(\lambda_n)$.

N.B.: $$\Omega(s,v,t) \equiv sK \left\{\frac{(1-v)t}{\phi(s+t)-\phi(s+vt)}\right\}^{k+1-K} \psi(s+vt) \frac{\{\phi^{(1)}(s+vt)\}^{k+1}}{\{\phi(s+t)\}^{K}}.$$

11. A Theorem on Generalized Absolute Summability

S. M. Mazhar, Allahabad

1.1. Let $C_\lambda^\alpha(w)$ denote the Riesz mean of type λ and order α, of the series Σa_n.

A series Σa_n is said to be summable $|R, \lambda, \alpha|_k$, where $k \geqslant 1$, $\alpha > 0$, $> \alpha k' > 1$ and $1/k + 1/k' = 1$, if the integral

$$\int_h^\infty w^{k-1} \left| \frac{d}{dw} C_\lambda^\alpha(w) \right|^k dw$$

is convergent, h being a finite positive number (Mazhar, Proc. Nat. Inst. Sci., India 26A (1960), 160-167).

1.2. The object of the present note is to prove the following theorem on the generalized absolute summability given above.

Theorem. *If* α *is a positive integer and* Σa_n *is summable* $|R, \lambda, \alpha|_k$, *then* $\Sigma a_n \lambda_n^{-\alpha+1/k'}$ *is summable* $|R, l, \alpha|_k$, *where* $l_n = e^{\lambda_n}$, $k \geqslant 1$ *and* $1/k+1/k' = 1$.

It may be observed that the above theorem includes, as a special case for $k = 1$, a well known theorem of Tatchell (J.L.M.S., 29 (1954), 49–59) for positive integral values of α.

12. On the Absolute Convergence of Fourier Series

B. S. Yadav, Baroda

Let $f(x)$ be L-integrable in $(0,2\pi)$ and periodic outside with period 2π and let

$$f(x) \sim \sum_{n=1}^{\infty} b_n \sin nx.$$

Set

$$\phi_x(h) = f(x+h) - f(x-h).$$

Izumi [J. Math. Analysis and applications, Vol. I. (1960), 184-194)] has proved the following :

Theorem : If (i) $\int_0^{\pi} \log^{2\pi/x} |\, df(x)| < \infty$ and (ii) the sequence $\{n^{\delta} \Delta\, (nb_n)\}$ is of bounded variation for some $\delta > 0$, then the Fourier series of $f(x)$ converges absolutely, that is $\sum_{n=1}^{\infty} |b_n| < \infty$. This has the cosine series analogue.

In this connection, we shall prove the following :

Theorem : If (i) $\int_{\mathbf{1}} |d\phi_x(h)| \leqslant A|h|^{\alpha}$, $\alpha > 0$, where $I : |x - x_0| < \gamma$, $\gamma > 0$, is any sub-interval of $(0,2\pi)$ and (ii) the sequence $\{n^{\delta} \Lambda\, (nb_n)\}$ is of bounded variation, then $\sum_{n=1}^{\infty} |b_n| < \infty$. We also have the cosine series analogue.

13. On the Absolute Harmonic Summability of the Associated Fourier Series and its Allied Series

Shiva Narain Lal, Allahabad

1. Let $f(t)$ be a periodic function with period 2π and integrable (L) over $(-\pi, \pi)$ and let the Fourier series of $f(t)$ be

$$(1.1) \qquad f(t) \sim \tfrac{1}{2} a_0 + \sum_{n=1}^{\infty} (a_n \operatorname{Cos} nt + b_n \operatorname{Sin} nt)$$

$$\equiv \Sigma A_n(t)$$

Then the allied series of the above series is

$$(1.2) \qquad \sum_{n=1}^{\infty} (b_n \operatorname{Cos} nt - a_n \sin nt) \equiv \Sigma B_n(t)$$

We write

$$\phi(t) = \tfrac{1}{2}\{f(x+t)+f(x-t)\} \tag{1.3}$$

and

$$\psi(t) = \tfrac{1}{2}\{f(x+t)-f(x-t)\} \tag{1.4}$$

We denote by $\{\lambda n\}$ any one of the following sequences,

$$1/\{\log(n+1)\}^{\varepsilon},\ \frac{1}{\{\log\log(n+1)\}^{1+\varepsilon}},\ \frac{1}{\log\log(n+1)\ \{\log\log\log(n+1)\}^{1+\varepsilon}}$$

$$1/\log\log(n+1)\ \ldots\ \log\log\log_{p-1}(n+1)\ \{\log\log\ \ldots\ \log_p(n+1)\}^{1+\varepsilon} \tag{1.5}$$

2. Recently Pati (On the non-absolute summability of Fourier series by a Nörlund method, under publication in the Jour. of Indian Mathematical Society has proved that "If $\phi(t)\log r/t$ is absolutely continuous in $(0,\pi)$ then the Fourier series is not necessarily absolutely Harmonic summable".

In this paper the author takes $\phi(t)\log(r/t)$ to be only of bounded variation and determines suitable factors $\{\lambda n\}$ that make the Fourier series absolutely Harmonic summable. Further the author also proves the analogue of this theorem for the allied series of Fourier series. More preciesely the following theorems have been proved.

Theorem 1. If $\phi(t)\log r/t$ $(\gamma > e^2\pi)$ is of bounded variation in $(0,\pi)$ then the factored Fourier series $\Sigma A_n(t)\lambda_n$ where $\{\lambda n\}$ is defined by (1.5) is absolutely Harmonic summable at the point $t = x$.

Theorem 2. If $\psi(t)\log\frac{r}{t}$ $(\gamma > \pi)$ is of bounded variation in $(0,\pi)$ and $|\psi(t)|/t$ is integrable over the same interval, then the associated allied series of Fourier series $\Sigma B_n(t)\lambda_n$ where $\{\lambda n\}$ is defined by (1.5) is absolutely Harmonic summable at the point $t = x$.

14. On the Absolute Riesz Summability of the Conjugate Series of a Fourier Series

S. M. Mazhar, Allahabad

1.1. Let $\lambda=\lambda(w)$ be a continuous, differentiable and monotonic increasing function of w in (k,∞), wihere k is a positive constant and let $\lambda(w)\rightarrow\infty$ with w.

We write

$$C_\alpha(w) = \sum_{n<w}\{\lambda(w)-\lambda(n)\}^\alpha a_n, \qquad (\alpha \geqslant 0).$$

A series Σa_n is said to be summable $|R, \lambda, \alpha|$, $\alpha\ \alpha \geqslant 0$, if the integral

$$\int_A^\infty |d[C_\alpha(w)/\{\lambda(w)\}^\alpha]|$$

is convergent, A being a finite positive number.

1.2. Let $f(t)$ be a periodic function with period 2π and integrable(L) over $(-\pi,\pi)$ and let the Fourier series of $f(t)$ be given by

$$f(t)\sim\tfrac{1}{2}a_0 + \sum_1^\infty(a_n \operatorname{Cos} nt + b_n \operatorname{Sin} nt),$$

then the conjugate series of the Fourier series of $f(t)$ is given by

$$\sum_{1}^{\infty} (b_n \operatorname{Cos} nt - a_n \operatorname{Sin} nt) = \sum_{1}^{\infty} B_n(t).$$

We write

$$\psi(t) = \tfrac{1}{2} \{ f(x+t) - f(x-t) \}$$

$$\psi_\alpha(t) = \frac{\ }{\Gamma(\alpha)} \int_0^t (t-u)^{\alpha-1} \psi(u)\, du, \qquad (\alpha > 0)$$

2.1. In this note we establish the following theorem.

Theorem. Let $0 < \alpha < 1$ and $\beta \geqslant 0$. If

$$\text{(i) } \psi_\alpha(+0) = 0$$

and

$$\text{(ii) } \int_0^\infty \left(\log \frac{k}{t} \right)^\beta \left| \frac{d\, \psi_\alpha(t)}{t^\alpha} \right| < \infty,$$

then the conjugate series $\Sigma B_n(t)$, at $t = x$, is summable $|R.e^{(\log w)^{1+\beta/\alpha}}, \gamma|$ *for every* $\gamma > \alpha$.

It may be observed that this theorem includes, as a special case for $\beta = 0$, a theorem of Bosanquet and Hyslop (Math. Zeit. 42 (1937), pp. 489–512). It also extends a theorem of Sinha (Proc. Nat. Inst. Sci. India, 24 (1958), pp. 155–175) to the cases $\beta \geqslant 0$ and $0 < \alpha < 1$.

15. On the Absolute Nörlund Summability of the Conjugate Series of a Fourier Series

T. Pati, Allahabad

Let $f(t)$ be integrable (L), periodic with period 2π, and let

$$(1) \qquad f(t) \sim \sum_{n=1}^{\infty} (a_n \operatorname{Cos} nt + b_n \operatorname{Sin} nt) = \sum_n A_n(t).$$

Then the conjugate series of (1) is

$$(2) \qquad \sum_{n=1}^{\infty} (b_n \operatorname{Cos} nt - a_n \operatorname{Sin} nt) = \sum_n B_n(t).$$

We write $\phi(t) = \frac{1}{2}\{f(x+t)+f(x-t\}$; $\psi(t) = \frac{1}{2}\{f(x+t)-f(x-t)\}$. Let Σa_n be an infinite series with partial sums s_n, and let $\{p_n\}$ be a sequence of constants with $P_n = p_0 + p_1 + p_2 + \dots + p_n \neq 0$. Then if $t_n = \sum_{\nu=0}^{n} p_{n-\nu} s_\nu / P_n \in BV$, that is, if $\sum_n |t_n - t_{n-1}| < \infty$, Σa_n is said to be summable $|N, p_n|$.

The author has recently obtained (Jour. London Math. Soc., 34 (1959), 153-160) a general theorem on the absolute Nörlund summability of a Fourier series at a point, which includes the well-known result of Bosanquet (Jour. London Math. Soc., 1936); if $\phi(t) \in BV(0, \pi)$, then $\Sigma A_n(x)$ is summable $|C, \delta|$ for every $\delta > 0$. In the present paper the author establishes the following theorem, which contains as a particular case the corresponding result on $|C|$ -summability of the conjugate series, due to Bosanquet and Hyslop (Math. Zeitschr., 1937).

Theorem. If $\psi(+0) = 0$, $\psi(t)\ \varepsilon BV(0, \pi)$, $\int_0^\pi (|\psi(t)|\ /\ t)\, dt < \infty$, and if $\{p_n\}$ is a positive monotonic sequence of constants such that $P_n \to \infty$ with n, $(n+1)p_n/P_n$ $\varepsilon\ BV$ and $\sum_{\nu=0}^{n} (\nu+1)^{-1} P_\nu\ /\ P_n\ \varepsilon\ BV$, then $\Sigma\ B_n\ (x)$ is summable $|N, p_n|$.

Differential Geometry

16. Curves and Invariants associated with a Vector Field of a Riemannian V_m in Relation to a Curve in a Subspace V_n.

C. N. SRINIVASIENGAR and K. NIRMALA, Dharwar

In two papers (*Tensor*, Vol. VI, 1956), and *Ganita* (Vol. 3, 1952), Dr. R. S. Mishra and Shri Krishna consider congruences in V_m, which are such that through each point of a subspace passes one curve of each congruence. Calling $\lambda_{T}/$as the tangent vector to the curve of one of the congruences, they define absolute curvature, and normal curvature of a curve C in V_n with respect to $\lambda_{T}/$. In this paper, we similarly introduce geodesic curvature of C *w.r.t.* $\lambda_{T}/$, and we obtain several neat results regarding these curvatures. We may mention here the elegant result :

The tendency of $\lambda_{T}/$ *w.r.t.* C in $V_m =$ its tendency *w.r.t.* C in $V_n - k_n \cos w_{T}/$ where k_n is the normal curvature vector of C, and $w_{T}/$ the angle between this vector and $\lambda_{T}/$.

17. On a type of Riemannian Space

M. C. CHAKI, Calcutta

This paper deals with a type of Riemannian space $V_n (n > 3)$ for which the covariant derivative of Weyl's conformal curvature tensor is everywhere zero. In the first few sections, spaces of this kind have been considered in relation to other well-known classes of Riemannian spaces defined by curvature restrictions. In the remaining part, the question of conformal mapping of Riemmanian spaces on such a space has been discussed.

18. Generalized Gauss, Codazzi and Kuchne Tensors

K. D. SINGH, Lucknow

Generalised Mainardi-Codazzi relations have been obtained by Mishra (1952) by taking tangents for a set of $(m-n)$ congruences of curves which are such that through each point of V_n embedded in V_m a curve of each congruence passes.

Gauss, Codazzi and Kuehne tensors and their derived tensors have been defined and studied by Blum (1946, 1947, 1955).

In this paper these tensors given by Blum have been generalised for a generalised Riemann space. It has been proved that these tensors do not explicitly depend upon the enveloping space and hence they have the same form as the corresponding tensors of the space with respect to an enveloping Euclidean space.

19. Parallelism and Covariant Differentiation in a Generalized Finsler Space

A. C. Shamihoke, Kanpur

A generalised Finsler space has been defined in this paper which essentially differs from a Finsler space in the non-symmetric character of the metric tensor. The approaches of both H. Rund as well as E. Cartan have been generalised, i.e., there are two types of generalised Finsler spaces: one constituting the generalisation of the Finsler spaces of H. Rund and the other constituting the generalisation of the Finsler spaces of E. Cartan. The problem of parallelism and covariant differentiation has been solved for both types of generalised Finsler spaces. The connection parameters found out for them reduce to the connection parameters Δ^{i}_{hk} of Eisenhart if the metric tensor $g_{ij}(x,\dot{x})$ is independent of the directional argument. The length of a vector undergoing parallel transport in the direction of its element of support remains unchanged for a generalised Finsler space based on an approach similar to E. Cartan.

20. Gauss-Codazzi Equations in a Hyperspace imbedded in a Generalized Finsler Space

A. C. Shamihoke, Kanpur

This paper deals with hypersurfaces of a generalized Finsler space with special reference to Gauss-Codazzi equations. The two sets of normals, projection factors, Coefficients of second and secondary second fundamental forms have been defined. Gauss-Codazzi relations have been obtained both with the help of the coefficients of second fundamental form as well as the coefficients of secondary fundamental form. Corresponding results for Finsler spaces and generalized Riemanniem spaces follow as particular cases.

Statistical Mechanics

21. Statistical Mechanics of Continuous Media : Vibrations of Membranes

N. E. Joshi and S. D. Nigam, Kharagpur

Methods of classical statistical mechanics have been extended to the mechanical system of infinite number of degrees of freedom and the vibrations of a circular homogeneous membrane with infinite radius have been studied. Vibrations only with circular symmetry have been considered. Suitable *function space*, instead of classical *phase space*, has been defined. To introduce a suitable probability measure the following two specific cases have been studied in detail.

1. The wave numbers are distributed according to the Poisson's distribution.
2. The function space consists of Wiener-Levy Brownian motion functions.

The random integrals thus arising, due to the randomness of the initial conditions, have been discussed.

In the case (1), the displacement and velocity turn out to be almost periodic functions in time and stationary in time. In (2) the displacement and velocity functions have been found to be random, normal functions, stationary in time. Necessary ergodic theorem has been proved.

Ballistics

22. The Second Ballistic Problem on the Theory of Motion of a Spinning Shell

P. C. Rath

In this note we have studied qualitatively the nature of small oscillations of the shell-axis about its normal position on the mean twisted trajectory. A solution of the second ballistic problem is obtained for the restricted case of low angle fire. As the motion along the mean trajectory is obviously of a stable shell, the characteristic lines of oscillations show a stable node at the normal position.

Elasticity

23. Note on Torsional Oscillations of a Semi Infinite Circular Cylinder with some simple types of Applied Twists at one End

A. K. Mitra, Calcutta

In the present note two very simple problems of torsional oscillations of a semi-infinite circular cylinder have been considered. The first problem is concerned with the setting up of disturbance in the cylinder by an impulsive twist applied at one of its ends, the curved surface of the cylinder being free from stress. In the second case it is assumed that the end experiences only a single pulse.

24. Bars Reinforced by Hyperboloidal Type Notches under Pure Bending

S. C. Das and R. Subramanium, Madras

Investigations have been made to obtain the stresses in a round bar with a circumferencial notch, generated by the rotation of a hyperbola about its axis coinciding with that of the bar, reinforced by another elastic material when the bar is under pure bending. Results have been obtained in closed forms. The cases of similar bars under torsion (Proc. Fifth. Cong. on Theo. & Appl. Mech., 1959) and under tension (Proc. Ind. Sc. Cong., 1961) have been previously dealt with by Das.

25. Stress Distribution in a Rectangular Plate of Piezoelectric Crystal under Normal Pressures

H. S. Paul, Kharagpur

Solutions of two-dimensional static problems of certain piezoelectric crystals have been solved by Fourier's method for rectangular plates. Two opposite edges of the plate are assumed to be free while normal pressures are applied on the other two edges. These edges are kept at zero electric potentials. The stresses, the strains and the electric displacements have been calculated. Numerical results for α-quartz have been given to illustrate the shearing stress distribution at free ends.

26. Two Dimensional Elliptic Inclusion

R. D. Bhargava and H. C. Radhakrishna, Kanpur

The simple concept of minimum potential energy of the classical theory of Elasticity first applied to solve Inclusion problems by one of the authors (RDB) to spherical and circular inclusions, has now been extended to solve elliptic inclusion problems. The complex variable method of determining the elastic field, first enunciated by Stevenson, A.C. in U.K. and Mushkelishvli, N.I. in U.S.S.R., has been used to determine the elastic field in the infinite material (called matrix) around the inclusion. Strain energies are calculated. The equilibrium size of an elliptic inclusion of elastic constants λ' and μ' differing from those of the matrix for which the constants are λ and μ has been determined.

The independent check on the calculations has been made by testing the continuity of normal and shearing stresses. The results also agree with the known results for much simpler case, when inclusion and matrix are of the same material.

27. On Magneto-Thermoelastic Plane Waves

Gunadhar Paria, Kharagpur

The propagation of plane waves in a thermoelastic body placed in a magnetic field has been investigated. It is shown that the problem can be reduced to one of pure thermoelasticity, provided, the longitudinal elastic wave velocity is suitably increased in the case of infinite electrical conductivity. For the finite electrical conductivity, however, the thermoelastic coupling factor is to be increased if the frequency is low.

28. Magnetoelastic Wave Propagation

P. D. Nigam, Kharagpur

The effect of uniform, externally applied magnetic field on the directional distribution and attenuation of waves created by a localized periodic body force in a homogeneous, isotropic elastic solid extending to infinity has been studied using a technique developed by Lighthill. In the absence of the magnetic field irrotational waves and the equivoluminal waves propagate in all directions with velocity V_p and V_s respectively and they decay like r^{-1} in all directions. In the presence of the magnetic field, the waves still propagate in all directions but the velocity of irrotational waves increases from V_p along the magnetic lines of force to $\sqrt{V_p^2+a_1^2}$ at right angles to them and they decay like r^{-1} in all directions. The velocity of equivoluminal waves increases from V_s at right angles to the magnetic lines of force to $\sqrt{V_s^2+a_1^2}$ along them and in certain directions they decay like $r^{-5/6}$ and in all other directions they decay like r^{-1}.

Fluid Mechanics

29. Görtler's new series Method for Compressible Laminar Boundary Layer Flows with Pressure Gradient and with or without suction

A. C. Jain, Bangalore

The aim of the present note is to extend the recent important method given by Görtler (J. Math. Mech., Vol. 6, No. 3, pp. 323–340, 1959) for incompressible flows with suction to compressible flows with suction. This aim is achieved by transforming the boundary layer equations for compressible flows to the forms obtained for incompressible flows through a number of transformations. The present analysis is carried out for the class of outer velocity distributions

$$U(x) = x^m \sum_{k=0}^{\infty} u_k x^{k(m+1)}, \; m \neq -1$$

(x being the distance along the body from its forward point) and the suction velocity distribution

$$v_0(x) = x^p \sum_{k=0}^{\infty} v_k x^{k(m+1)}$$

when the Prandtl-number is unity, viscosity-temperature relation is linear and there is no heat-transfer. Salient features of the present method are the following :

(i) The effect of compressibility appears only in the transformation of the tangential and normal coordinates and in the coefficients of the principal function.

(ii) The present analysis does not require more universal functions than are necessary for the incompressible flow with suction. The case of an impervious wall appears as a particular case.

(iii) Similar solutions are obtained as a particular case when $M_1 \propto (\xi_2)^{\beta_0/2}$ and $v_0(x) \propto \xi_2^{\frac{1}{2}(\beta_0-1)}$ when M_1, a_1 are respectively the Mach number and the velocity of sound in the outer flow and ξ_2 is related to x.

(iv) Calculations are extended upto the fifth order approximation so as to make full use of the available integrated universal functions.

(v) In the case of an impervious wall, the effects of compressibility and pressure gradient on the skin-friction is studied by means of a number of graphs.

30. Slow Motion of a Non-Newtonian Liquid past a sphere

(MISS) S. L. RATHNA, Bangalore

The theory of non-Newtonian fluids is based on the stress-rate of deformation relation given by

$$T = -pU + \phi_1 E + \phi_3 (E.E),$$

where T, E, p, ϕ_1 and ϕ_3 are the stress tensor, rate of deformation tensor, pressure and coefficients of viscosity and cross-viscosity respectively. In the present paper, the flow of a non-Newtonian liquid past a sphere of radius a, which, at infinity is uniform, has been studied. For small Reynolds number the inertia terms can be neglected in comparison with viscous terms. The stream function is obtained in terms of a non-dimensional parameter $R = \dfrac{\phi_3 U}{\phi_1 a}$, where U is the velocity of the uniform stream. Assuming R to be small, only terms upto the second power in R have been retained. The zeroth order approximation corresponds to the Stokes' solution for the Newtonian fluid.

The drag on the sphere and the pressure distribution have been obtained. Unlike the case of visco-elastic fluids, the drag on the sphere to present approximation is greater than the drag due to a Newtonian fluid by the quantity $255.7512\, \pi a U \phi_1 R^2$. The effect of cross-viscosity on the stream lines have been represented graphically.

31. Laminar Boundary Layer on Rotating Sphere and Spheroids in Non-Newtonian Fluids

(Miss) G. K. Rajeswari, Bangalore

In this paper the three dimensional laminar boundary layer equations are deduced in orthogonal curvilinear coordinates, in non-Newtonian fluids, whose constitutive equation is given by

$$T = -pI+\phi_1 E+\phi_3(E.E)$$

where T is the stress tensor, p an hydrostatic pressure, E is the rate of deformation tensor, I the idem tensor and ϕ_1 and ϕ_3 are the constant coefficients of viscosity and cross-viscosity respectively. Making use of these boundary layer equations, the flows in the boundary layer generated by a rotating sphere, rotating prolate and oblate spheroids are investigated separately. When these bodies of revolution are rotated about the axis of revolution, in an otherwise undisturbed fluid, the accompanying secondary stream causes the fluid to flow into the boundary layer near the poles and out of it at the equator. Near the poles the flow is the same as that due to rotating disc. However, the phenomenon in the plane of the equator where the two boundary layers impinge on each other and are thrown outwards can no longer be analysed with the aid of the boundary layer theory. The effect of cross-viscosity on the flow is discussed within the boundary layer originating from the poles on these rotating bodies before they impinge on each other near the equator. All the velocity components are expressed in terms of the series in powers of sin θ, θ being the angle measured from the axis of rotation in a meridian plane and the coefficients are purely functions of the normal distance from the surface of the revolution. These unknown functions are determined using the Karman-Pohlhausen method. The effects of cross-viscosity are represented through a non-dimensional parameter $K = \dfrac{\gamma\Omega}{\alpha}$, where α, γ, Ω are respectively the kinematic coefficients of viscosity, cross-viscosity and the uniform angular velocity of the rotation of the body. The effects of both positive and negative K on the flow functions are illustrated graphically.

32. Shear Flow of an Elastico-viscous Fluid past a Flat Plate with Suction

Shankar Prasad Misra,* Kharagpur

The shear flow of an Elastico-viscous fluid past a flat plate with suction has been studied by considering the constitutive equations

$$\tau^{i}_{j} + \lambda_1 \tilde{\tau}^{i}_{j} = 2\mu d^{i}_{j}$$

$$\rho\left\{\frac{\partial v^i}{\partial t} + v^{i}_{,j} v^j\right\} = -\frac{\partial p}{\partial x_i} + \tau^{i}_{j,j}$$

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where

$$\overset{\sim}{\tau}{}^{i}_{j} \equiv \frac{\partial \tau_j{}^i}{\partial t} + \tau_{,}{}^{ij}{}_{k}\, v^k - \tau^{ik}\, v^j{}_{,k} - \tau^{kj}\, v^i{}_{,k}$$

is the rate of stress tensor,

$$2d^{i}_{j} = v_{,i}{}^{j} + v_{,i}{}^{j}$$

is the rate of flow tensor, v^i is the velocity vector and p is the mean pressure, λ_1 is an elastic parameter, μ is a coefficient of viscosity.

The discussion shows that the presence of elastic element in a shear flow decreases the boundary layer thickness. A non-zero normal stress $\tau_x{}^x$ is found which is necessary to stabilize the flow. The order of the boundary layer thickness remains unaffected whether the plate moves or is at rest. A previous result of Sakurai restricted the appearence of boundary layer nature to the case of suction only. But here the boundary layer appears in case of injection also.

33. Three Dimensional Flow round a Mountain

P. K. Das, New Delhi

The present paper attempts a solution of the problem of three dimensional flow round a mountain. The basic motion is assumed to be steady with a mean zonal current which does not change with height. The presence of the mountain is taken to produce perturbations on the basic current. After linearising the perturbation equations, a partial differential equation is developed for the vertical component of perturbation momentum. The solution of this equation is obtained in terms of a Green's function for an infinite region.

Mathematical Physics

34. Causality and the Dispersion Formulae for Waves in a Plasma

T. Pradhan, Cuttack

The principle of causality which states that the effect cannot precede the cause, is invoked to obtain the correct prescription for integrating across the pole in the dispersion formulae for the longitudinal and transverse waves in a collision-free plasma obtained by the simultaneous solution of Maxwell's electromagnetic and linearised Boltzmann's transport equations. Conditions for growing and decaying waves are obtained from the results that follow from the above prescription. An analysis of the nature of the initial disturbance is also given.

35. Field Operators and their Analytic Properties

S. P. Misra, Cuttack

The analytic structure of the Fourier transforms of the field operators for positive times is examined. Asymptotic conditions of coordinate space is related to the analyticity property in momentum space, but it has not been possible to utilise it in the perturbation analysis. For menson-nucleon system, which is taken as an illustration, it is seen that the degree of divergence for mass renormalisation is sensitive to the way in which the singularity in complex k_0-plane is taken, and about this we do not have any convincing mathematical or physical reasons except *ad hoc* assumptions based on the possibility of an iterative solution.

36. Oscillations of a three-component assembly in the presence of magnetic field using the Generalization of BGK-collision model

P. L. BHATNAGAR and C. DEVANATHAN, Bangalore

The model collision process for a single component assembly of particles proposed by Bhatnagar, Gross and Krook has been generalized for a multicomponent assembly of both charged and neutral particles. The method of obtaining the collisional temperatures and velocities from phenomenological laws is given. Applying this, exact continuum equations of an assembly composed of ions, electrons and neutral particles have been derived and small amplitude oscillations are studied. Confining the attention to the propagation perpendicular to the magnetic field the transverse and longitudinal part separate out. Due to the presence of neutral particles, Landau damping occurs, as the particles moving with the velocity of wave deprive the assembly of their kinetic energy, due to resonance. In the presence of the magnetic field, there would be no oscillation with frequency near the integral multiples of gyrofrequency of electrons and ions. Apart from these microscopic effects it has been found that there could be no transverse oscillation below the critical frequency $\sqrt{4\pi e^2 N_0(\frac{1}{m_1}+\frac{1}{m_2})}$, and in the presence of a strong magnetic field, there are bands of frequency range inside this at which transmission could take place. These depict the high medium like behaviour of the assembly. Thus the proposed method is capable of treating both the microscopic and macroscopic properties simultaneously. Further, because of the simplicity of the model, collisional effects can be evaluated directly.

Relativity

37. Homogeneous Non-Static Electromagnetic Fields in General Relativity

BIDYUT KUMAR DATTA, Calcutta

The paper presents the spatially homogeneous solutions of the Rainich equations of the 'already unified theory' for the case when the field is non-static and the diagonalised metric tensor components are functions of time alone. Except for some specified values of time, the solutions are everywhere regular.

SECTION OF STATISTICS

PRESIDENT : DR. C. CHANDRASEKARAN

Abstracts

Statistical Inference

1. Minimum Logit χ^2 estimates of parameters using the logistic functions

A. P. BASU, Kharagpur

In Test theory, it has been pointed out by several authors that in situations in which "an integrated normal response law" is assumed, the logistic function provides a useful alternative to the probit model. In this paper parameters have been estimated by the minimum logit χ^2 method using the logistic model and the advantage of these estimates over the corresponding maximum likelihood estimates have been discussed.

2. On a test for the Scale Parameter of the Truncated Exponential Distribution

ASITPRAKAS BASU, Kharagpur

In sampling from an exponential distribution the assumption that the random variable X is defined over $(0, \infty)$ is not always a realistic one and a sample of n from an exponential distribution is in reality a sample of n from a truncated exponential distribution. In this paper we have examined the effect of applying same usual test of hypothesis to the case when the sample is known to have come from a truncated exponential population and have shown that there will always be some negative "loss of power" of the test.

3. Simplified method of fitting the doubly or singly truncated Negative-Binomial distribution

C. G. KHATRI, Baroda

By defining the doubly truncated Negative-Binomial distribution as

$$P_j = \binom{k+j-1}{j} \theta^j \Big/ \sum_{j=a}^{b} \binom{k+j-1}{j} \theta^j$$

where $j = a, a+1, \ldots, b$, $\alpha \geqslant b > a \geqslant 0$, and $0 < \theta < 1$, we propose the estimates $\bar{\theta}$ and $\bar{k}$ as

$$\bar{\theta} = A/B \quad \text{and} \quad \bar{k} = C/A$$

where $A = [\Sigma i(i+1) f_{i+1}] \ (\Sigma f_i) - [\Sigma (i+1) f_{i+1}] \ (\Sigma i f_i) + \Sigma i f_i - a f_a$, $C = [\Sigma (i+1) f_{i+1}]$ $\Sigma i^2 f_i) - [\Sigma i(i+1) f_{i+1}] \ (\Sigma i f_i) - \Sigma i^2 f_i + a^2 f_a$ and $B = (\Sigma i^2 f_i) \ (\Sigma f_i) - (\Sigma i f_i)^2$, by taking f_i the observed frequency at $j = i$ and Σ the summation over i from a to $b-1$. The formula for the asymptotic efficiency of these estimates are established and the above estimates are found to be reasonably efficient (a) for exploratoiry work and (b) for solving the maximum likelihood equations. In a numerical example, the fitting is done by the method of maximum likelihood and by the simplified method.

4. On Multi-sample Non-parametric Location Tests Based on the Differences of Exceedances on Complementary Sample Quantiles

Pranab Kumar Sen, Calcutta

Non-parametric median tests for multi-sample location problems are due to Mathisen (1943), Mood (1949), Brown and Mood (1951), among others. Here is studied the following test.

Let $x_{1(r)}$ and $x_{1(n_1-r+1)}$ be respectively the p-th and the $(1-p)$-th sample quantiles of the first sample $(0<p\leqslant\frac{1}{2})$ and let in the i-th sample of size n_i, K_{i1}(and K_{i2}) observations have values less than $x_{1(r)}$ (and greater than $x_{1(n_1-r+1)}$) for $i = 1,\ldots,c$. The proposed test is then based on $K_i = K_{i1} - K_{i2}$ for $i = 1,\ldots,c$. It may be noted that in the particular case $p = \frac{1}{2}$ our test reduces to the median test.

The consistency, asymptotic power and power-efficiency of the test are studied here and it has been shown here that we can always find a value of p, such that our test will be at least as efficient as the median test.

In cases where the efficiency of the median test is quite low, we can have more efficient tests from the class of tests referred to above.

5. On the Role of Non-parametric Inter-quantile Tests in Some Multi-sample Scale Problems

Pranab Kumar Sen, Calcutta

Let $x_{i1},\ldots,x_{in_i}$ be n_i units drawn at random from a population with a (unknown) continuous cumulative distribution function $F_{i(x)} = F([x-\mu_i]/\delta_i)$ where μ_i and δ_i are respectively the location and the scale parameters of the i-th population for $i = 1,\ldots,c$ $(c\geqslant 2)$. The first problem relates to testing the homogeneity of the scales, assuming the identity of the locations and the second problem relates to testing the homogeneity of the scales without presuming the identity of locations.

The inter-quantile tests proposed here are consistent for the first problem and their power properties are studied here and compared with that of the Quantile teste. For the second problem, obviously the ordinary inter-quantile tests are not consistent and accordingly, the observations are centered at their respective locations, as estimated from the samples. The inter-quantile tests based on these centered values are consistent and asymptotically distribution-free, under certain regularity conditions and have the same power properties as that of the ordinary inter-quantile tests. But quantile tests based on these centered values, fail to be distribution-free, even under somewhat more restrictive regularity conditions. Hence, the supremacy of our test.

6. Maximum Likelihood Estimation of a Truncated Chi-distributed Radial Error from Grouped Observations

B. K. Shah and C. G. Khatri, Baroda

The frequency function of the radial error is

$$f(x) = C(x^{p-1} / \sigma^p) \exp(-x^2 / 2\sigma^2),\ 0<x<\infty,\ \sigma>0$$

where C is not depending on σ, and p is known. The observations in the range

$x_1 \leqslant x \leqslant x_{k+1}$ are grouped into k specified intervals with end points $x_2, \ldots, x_{k+1}$ and let the frequency in the i-th group be n_i $(i = 1, 2, \ldots, k)$. The maximum likelihood equation for σ is established for any p and in particular when $p = 2$, it is given as

$$\Sigma n_i \left[-\frac{\phi_{i+1}\left(x_{i+1}^2 - x_i^2 \right)}{\phi_i - \phi_{i+1}} + \frac{\phi_{k+1}\left(x_{k+1}^2 - x_1^2 \right)}{\phi_1 - \phi_{k+1}} \right]$$

$$+ \Sigma n_i \left(x_i^2 - x_1^2 \right) = 0$$

where

$$\phi_i = (2\pi)^{-\frac{1}{2}} \exp^{\left(-t_i^2/2\right)} \quad \text{and } t_i = x_i/\sigma.$$

Also, it is shown that the first term in the above equation is monotonically decreasing as σ increasing from 0 to ∞. This property helps in solving the above equation.

Applied Statistics

7. On the 'Zero Error' in data collection

M. A. El-Badry, Bombay

It has been observed that enumerators sometimes fail to record a zero answer properly on the schedules. Contrary to the instructions, they leave the relevant space blank or fill it with a mark different from the one given in the instructions (like *a* '—' for example). When the schedules are returned for processing, such cases are ambiguous and the coders have no way of knowing whether a zero answer or a 'not given' answer is intended. A frequent procedure is to tabulate these ambiguous cases in the 'not given' category.

This paper shows the existence of this error in the census data on 'number of children ever born' which have been collected in many countries, particularly those of South East Asia, including the experience of two Indian states in the 1951 census. A study of the covariation of the proportions tabulated as childless and as 'not given' in the various age groups has shown the existence of a linear or nearly linear relationship between the two proportions in many instances. The linearity can be utilized, as explained in the paper, to detect the existence of the error and to adjust the data.

8. Construction of Rotatable Design through balanced incomplete Block Design with unequal sizes

M. N. Das and V. L. Narasimha, New Delhi

A method of construction of second order rotatable design through balanced incomplete block design with unequal block sizes, has been described. Through this method such designs with any number of factors can be obtained. In the case of many designs the number of points required for a design is very much lower than that obtainable through ordinary B.I.B. designs and other methods.

9. Some important Psychophysical Laws examined

AMAL KUMAR MALLICK, Calcutta

In order to put them to an empirical test, three important Laws of Psychophysics, viz., Weber's Law, Fulberton-Cattell's squareroot law, and Guilford's n-th power function law, have been applied to some sets of data on temporal estimation obtained in a psychophysical experiment. How far each of the laws is applicable to the data has been examined by studying the relation between the experimental observations and the theoretical expectations. Which of the laws conforms best to the data, i.e., to which law the data give satisfactory fit, has been examined.

10. A Note on Spatial (regional) Productivity Changes

GIRIJA PRASAD MUKERJI, Calcutta

Temporal studies on 'Productivity Changes' (Nicholson and Gupta JRSS 1960) show high positive correlation between 'Productivity Changes' and 'output'. Similar relationships have been observed by Lomax (JRSS, 1959). Maddison (Bull. Oxf. Inst. Stat. 1955) and Solomon Fabricant (NBER Occ. Paper 63, 1959) between Productivity changes, output and allied factors. The 'Spatial' counter study attempted here does not reveal any such marked association for Indian industries.

Here only six major industries are studied viz. jute, cotton, sugar, cement, paper and iron and steel. Data from the final report of the eleventh census of Indian manufactures have been used. Rank correlation co-efficient between Productivity (defined as output per man-hour) changes and output, employment, earnings, plant and machinery, cost of production, value added by manufacture and degree of mechanization are studied. The fluctuation of the rank correlation coefficient is rather wide and as such no definite conclusions can be reached except that there seems to be no marked association between 'Productivity Changes' and 'output' (as recorded for temporal counterpart). Cost of production also appears to be somewhat negatively associated with productivity.

11. On the Economic Aspects of Sampling Inspection

S. S. RAJPUT and N. K. CHAKRAVARTI, Kanpur

Sampling inspection is not necessarily more economical than 100% inspection, and hence arises the need to investigate conditions which must be satisfied in order for sampling inspection to be more economical. These conditions have been developed in acceptance-rejection, and acceptance-rectification plans. The conditions turn out to be simple inequalities involving fraction defective in the accepted lots (or processes average), sampling fraction, and probability of acceptance of a lot having fraction defective equal to process average. The sampling scheme is to be tested for economy in three steps, so that it is convenient to apply in practice. It saves a lot of computational labour as well, in the sense that if some initial conditions are not satisfied, we reject the plan immediately, thereby saving heavy computations for later conditions.

The risk of resubmission of already rejected lots is discussed here. The conditions that tempt a supplier to resubmit already rejected lots, and the effective counter-measures that the customer may adopt, have been discussed.

Purchasers of stray and infrequent lots are not interested in protection on the average, but in protection in respect of the submitted lot itself. They are thus primarily interested in the LTPD. It is shown that even in such cases, AQL has to be an important consideration.

The above represent considerations of economy achievable immediately on introduction of sampling inspection. From the long term point of view, sampling inspection is preferable to screening in order to provide the proper incentive to the suppliers for improving the quality of their produce.

12. A study of relative performances of college students of different Ages

J. Sarangi, Cuttack

In pursuance of the query of the University Grants Commission into the desirability of imposing a minimum age limit for admission into first year of the 3-year degree course, the author compared the academic performances of students of different ages in the I.A. examination. Taking the total of standardised scores as the index of merit, the F-test of significance established age as an assignable cause of variation of academic performances at 1% level of significance. Arranging the mean scores in decreasing order of magnitude, the different age-groups could be ranked as follows :

16, 17, 15, 18, 14, 19, 22, 21 and 20

Critical differences between successive age-groups revealed no tangible differences. But the average performance of the 16 and 17 or 16, 17 and 15 taken together is superior to the average performances of the other age groups even at 1% level. The average performance of the 20, 21 and 22 groups taken together is inferior to each one of the remaining age-groups at 1% level. Thus whereas students of 16 and 17 age-groups have best performances in colleges, those that cross the twentieth year are far inferior to the rest.

13. Selection within lines in a mixed population

S. N. Sen, Patna

In any system of inbreeding, the population divides into a number of lines. Any amount of selection within lines ultimately leads to the complete homozygosity of the population (Haldane, 1956). In the mixed population where both selfing and natural crossing are present in varying proportions, the rate of disappearance of the heterozygosity at successive generations will be at a slower rate than in case of purely self-fertilized populations. Different cases of selection procedures arising in such mixed populations have been studied earlier in detail (Sen, 1958 and 1960).

In the early stages of the breeding programme, the heterozygous lines split and out of them, some homozygous lines are discarded in each generation. Selection within lines in the mixed population, where some homozygous lines obtained by selfing the heterozygous lines are at disadvantage, are discussed in the present paper. Cases where the measures of selections for the two homozygous lines are either equal or unequal have been studied. If homozygosis is being sought, then the inbreeding should be as close as possible.

14. A Method of Estimating variable Engel Elasticity

Paras Nath Singh, Calcutta

It is well known that the elasticity of demand for any commodity varies with income or total expenditure. This problem has been attacked by extending the famous double log form, wherein the elasticity of demand is supposed constant. The formulation suggested has some of the interesting properties of demand functions.

It has been shown that the basic parameter occurring in the suggested formulation can be estimated with the help of the concentration curves, provided the distribution of total per capita consumption can be described by three parameter log normal distribution. The parameter can also be estimated using least square techniques.

Some empirical studies have also been made, and the elasticities have been given at mean total expenditure of the expenditure classes. However, the significance of these estimates is more or less illustrative, because the third parameter occurring in the log normal distribution has been arbitarily fixed.

15. Simulation of Third Order Systems with one Operational Amplifier

L. K. Wadhwa, Delhi

The third order linear system simulation by electronic analog computers is generally done with two or more operational amplifiers by techniques that are very well known.

A method has been discussed in this paper which shows that third order linear systems can be simulated with the aid of only one operational amplifier and a few two-terminal impedances consisting of resistors and capacitors only.

Three possible circuits capable of simulating a particular case of the general third order linear system have been presented and the resulting third and fourth order non-linear algebraic equations have been solved for determining the validity conditions and the circuit component values.

The method of simulation is simple. If the validity conditions are satisfied then a physically realizable net-work consisting of one operational amplifier, three capacitors, five resistors exist and the component value may be easily calculated from the equation developed in the text.

16. One Operational Amplifier Simulator for a Third Order System with a Leading Time-Constant

L. K. Wadhwa and Jagdish Chandra, Delhi

In another paper presented to this session, one particular case of a general third order system was considered. In this paper another case of the general third order linear system with one leading time-constant is considered.

Only three of the possible sixteen circuits are discussed in the text. The circuits given in the text have been analysed and the resulting third degree non-linear algebraic equations have been solved with a view to determining the validity conditions and the component values.

The method of simulation is simple. If the validity conditions are satisfied then a physically realisable network consisting of one operational amplifier, four capacitors and four resistors exists and its component values may be easily calculated from the equations developed in the text.

Demography

17. Sources affecting knowledge and use of certain Family Planning Methods: Some Indices for Assessment

PRAFULLA C. BEBARTA, Bombay

An attempt is made in this paper to devise certain indices to assess the role of different information sources in the propagation of certain family planning methods. Three indices were constructed to measure the role with reference to (1) Knowledge, (2) Use and (3) Knowledge and use, of the methods. The assessment was made with respect to specific sources and also with reference to specific methods and sources.

The knowledge index was constructed by taking the ratio of persons who obtained knowledge about methods from a specific source to the total number of persons with knowledge of methods. A similar index, using in the numerator the number of users who obtained knowledge about methods from a specific source, formed the use index. The knowledge-use index was obtained by working out the ratio of the use and knowledge indices.

The indices were applied to data obtained from 666 women specially interviewed in Bombay City. The findings reveal that different sources perform different functions in the propagation of methods. The study has methodological as well as practical implications.

18. An Evaluation of the Parity Data collected at Birth Registration in Bombay

M. A. EL-BADRY, Bombay

Unlike many other eastern localities, Bombay has a high proportion of its births, as high as about 85%, taking place in hospitals. As these births get automatically registered, the percentage of registration is considered to be quite high. This fairly high degree of completeness has encouraged us at the Demographic Training and Research Centre, Bombay, to utilise the information on parity available on the birth certificate, namely the order of pregnancy and the order of live birth, to assess fertility differences between various socio-economic strata in the city.

The present paper is confined to a pilot study undertaken by the Centre to evaluate the accuracy with which these data on parity are reported. For that purpose, it was decided to take a sample of 1000 mothers of babies born within one year, interview and question them about the details of their marital and pregnancy histories and then match the interview figures on pregnancies and live births with their registration counterparts.

The study revealed the existence of errors in the registration data, due to the wording of the questions as well as to the procedures by which the information was collected. A number of suggestions for enhancing the accuracy of the data are made in the paper.

19. Techniques for projecting urban-rural Populations and Labour Force

T. B. Im, R. E. Choudhuri and K. V. Ramachandran, Bombay

Many of the economically under-developed countries of the ECAFE region have in recent years exhibited several similarities with regard to demographic and other characteristics. Quite a few of them have recently emerged as independent nations faced with tremendous problems of economic and social reconstruction and development. The population growth in most of these countries are very large mostly due to reduced mortality rates, with no corresponding reduction in fertility rates. The need for planned economic and social development on the basis of the demographic variable requires no special stress.

The demographic statistics of most of these countries leave much to be desired. Many of them even lack the essential pre-requisites of even a recent census, letting alone the availability of registration or survey data. Manpower resources and labour force estimations thus become particularly difficult.

The labour force is affected by several social, economic and psychological factors. Urban-rural characteristics, age and sex play important roles. Some of the other factors may be marital status, family responsibilities, education and so on. Many of the countries may have data at the most on labour force participation by age, sex and urban-rural characteristics.

This paper essentially deals with the tecchniques of projecting the urban and rural populations by age and sex and using these in conjunction with the projected labour force participation rates also by age and sex. A new technique of projecting the labour force participation rates is also indicated.

The method is applied to estimate the labour force in the Republic of Korea.

20. A study on twinning

K. R. Rajagopalan, Madras

The paper is a study about Births and Twin Births for the decade 1949–58 in Madras City. The data were obtained from all the five of the Maternity Hospitals—three of them being Government and the other two privately-managed. The rate of twinning works out to 12.75 per thousand births for this decade or one twin birth for every 78.6 births. This figure is based on a total of 255 thousand births. If figures for earlier years are also taken into consideration, we get a rate of 12.70 per thousand or one twin birth for 78.7 births. This figure covers 371 thousand births, and is for the period 1941–58. Comparative rates for the five hospitals range from 14.5 per 1000 to 8.7 per 1000. Further analysis relating to the age of the mother, and parity on twinning, nature of twinning etc., are in progress.

21. The Process of Urbanization in Andhra Pradesh

V. V. B. Rao and R. S. S. Sarma, Bombay

An attempt is made in this paper to study the process of urbanization during the period 1901–1961 in Andhra Pradesh. The following conclusions have been reached :-

Rapid industralization has not set in for Andhra Pradesh and the process of urbanization has received a spurt only in recent decades. The pattern of urbanization observed till 1961 can hardly be described by a logistic approximation. An exponential trend is found to be close to the observed pattern of urbanization.

The State of Andhra Pradesh is still predominantly agricultural. A trend towards urbanization in the beginning of the century was checked somewhat between 1911 and 1921 by the floods and epidemics during the period in the cities of Hyderabad and Warangal.

The period 1941–1961 has seen the beginning in the process of urbanization accompanied by industralization. With the advancement of industries, urbanization in Andhra Pradesh can be expected to grow at a progressive rate in the coming two or three decades.

22. A new approximation to the true infant mortality rate

RANJAN KUMAR SOM, Calcutta

The computation of the true infant mortality rate (IMR) for the cohort of (live) births in a calendar year requires the tabulation of infant deaths by the calendar year of birth : this information is not often available, and even when available, can be obtained only after the passing of the next calendar year. In this paper, a new approximation to the true IMR has been proposed. This assumes the constancy (over time) of the ratio of the number of infant deaths in the next calendar year to that in the same calendar year as that of birth and has been seen to be better, on the criteria of (1) number of closest values; (2) average deviation; and (3) rootmean square deviation, than the other available approximations when applied to the Swedish data of 1914–45.

SECTION OF PHYSICS

PRESIDENT: PROF VIKRAM A SARABHAI, M.A. (Cantab.), Ph.D.

Abstracts

1. On the Singlet → Triplet Absorption in a few Polysubstituted Benzenes in the Vapour State

J. K. **ROY** and S. C. **SIRKAR**, Calcutta

The absorption spectra in the near ultraviolet region of ortho-, meta- and para-fluorotoluene, *m*-chlorotoluene, 2,4-dichlorotoluene, and 3,4-dichlorotoluene in the vapour state and with a path length equivalent to about 7 mm of the liquids have been investigated and compared with those due to equivalent path lengths of the liquids. In the case of 2,4-dichlorotoluene and 3,4-dichlorotoluene the spectra have also been photographed with the vapours at about 205°C using a high dispersion spectragraph.

It has been observed that these vapours exhibit continuous absorption starting at different points in the region lying between 26000 cm^{-1} and 29000 cm^{-1} and increasing towards shorter wavelengths. When the vapours are liquefied the region of absorption shifts towards shorter wavelengths, the shift being larger for ortho compounds than for the para compounds, but the long wavelength limit in the spectra of the isomeric molecules in liquid state are almost identical. It has been found that the spectra due to the vapours at different temperatures are identical. These results have been discussed.

2. On the Electronic Spectra of 1,2,4-trimethylbenzene in the liquid and solid states

T. N. **MISRA** and A. K. **CHAKRABORTY**, Calcutta

The near ultraviolet absorption spectra of 1,2,4-trimethylbenzene in the liquid state and in the solid state at −180°C have been studied and the results have been compared with those for the substance in the vapour phase as reported by earlier workers. In the liquid state four broad bands are observed and the 0,0 band is at 36185 cm^{-1}, displaced by about 715 cm^{-1} towards red from that observed in the vapour phase. When the liquid is solidified and cooled to −180°C, the bands become sharper and seven prominent bands are clearly resolved. The strong 0,0 band is at 36368 cm^{-1} and thus on solidification and cooling to −180°C, the band system is shifted towards high energy region by about 183 cm^{-1} with respect to that in the liquid state. These results have been discussed in terms of influence of intermolecular field in the crystal lattice on the electronic energy states of the free molecule.

3. On the Raman Spectra of Acetylacetone in the Solid State at −180°C

M. **MAZUMDER** and S. B. **ROY**, Calcutta

The Raman spectrum of acetylacetone in the frozen state at −180°C has been photographed and compared with that of the liquid at about 30°C. It has been observed that the intensity of the line 1596 cm^{-1} compared to that of any other line in the region 1000–1400 cm⁻¹ does not diminish very much with solidification of the substance and cooled down to −180°C. Also a sharp new Raman line of shift 53 cm⁻¹ appears in the spectrum due to the solid at −180°C. It has been concluded that the origin of this new line is due to intermolecular vibration and probably dimers are formed in the solid state giving rise to such vibrations. It is further concluded that the structure of the molecule does not change appreciably with the change from the liquid to the solid state.

4. On the Electronic Spectra of Parabromophenol in different States

T. N. MISRA and S. B. BANERJEE, Calcutta

The ultraviolet absorption spectrum of *p*-bromophenol in the vapour state has been analysed, assuming the molecule to belong to the C_{2v} point group. The intense 0,0 band of the spectrum, which is due to an allowed A_1-B_1 transition, is found to be at 34784 cm^{-1} and the observed frequencies are 259, 297, 528, 645, 732, 913, 1019, 1137, 1240 and 1542 cm^{-1} in the excited state and 288 and 322 cm^{-1} in the ground state. The main features of the absorption system have been discussed.

The spectra of the compound in the liquid state and in the solid state at room temperature and at −180°C consist of broad bands. The 0,0 band of the crystal at room temperature shows a red shift of 157 cm^{-1} with respect to that observed in the case of the vapour state, while with lowering of temperature of the crystal to −180°C only a negligible further shift is observed. These changes have been discussed in the light of the existing theories of interaction of molecules in the lattice.

5. Infra-red Spectrum of Solid SiF_4

V. SETHURAMAN, Bombay

Infra-red spectra of SiF_4 in the vapour phase at room temperature and the solid phase condensed on a KBr window at 77°K have been recorded in the 2.5 –25μ region. Changes in the spectra between the two phases have been studied.

After the condensate of SiF_4 is evaporated away, the KBr window is still coated with a white residue. The infra-red spectrum of the residue has been recorded at room temperature and at 77°K. Some of the peaks obtained agree with those of K_2SiF_6, indicating reaction with the window.

6. Spectroscopy of Trapped Radicals

S. L. N. G. KRISHNAMACHARI and S. R. DESHPANDE, Bombay

An apparatus has been assembled to trap free radicals at liquid nitrogen temperatures. The free radicals produced in a microwave discharge through ammonia vapour are condensed on a liquid nitrogen cooled pyrex glass surface. The condensed deposit gave a greenish glow. The conditions required for making the glow more intense and stay for longer times are being studied. The spectrum of this glow is being studied and will be presented.

7. The $^1I_6$ State of Pr^{3+} in $LaCl_3$ at 77°K

R. M. AGRAWAL, R. C. NAIK and D. RAMAKRISHNAN, Bombay

Single crystal of 5% Pr^{3+} in $LaCl_3$ has been grown by Stockbarger's method and its absorption spectra at 77°K have been recorded in the region λλ 4200 – 5400 A on a grating spectrograph having a dispersion of 5A/mm in the first order. Polarization of the absorption lines has also been obtained. Additional lines in the group arising from $^3H_4 \rightarrow {}^1I_6$ have been observed and are accounted for satisfactorily. One additional stark level in $^1I_6$ at 21407 cm^{-1} has been established. For a few lines the polarization results obtained here do not agree with those of previous workers.

8. An Ultra-Violet Selective Filter

M. N. Dixit, Bombay

A selective filter for the ultraviolet region, making use of the carbon bisulfide vapour absorption band between 3000 Å and 3300 Å is described.

The use of this filter in photographing certain P_2 bands in the fifth order of a 3.4 meter 30,000 lines/inch grating spectrograph without the overlapping orders is discussed.

9. Rotational Structure of the F–X Band System of the $Cu^{65}Cl^{35}$ Molecule

R. K. Asundi, J. K. Brody* and P. Ramakoteswara Rao, Bombay

The F–X band system of $Cu^{65}Cl^{35}$ (3700–4200 Å) obtained in emission has been photographed under high dispersion. Rotational structure of (3,0); (2,0); (1,0); (0,0); (0,1) and (0,2) bands of the system has been analyzed. The electronic transition involved is shown to be $^1\pi - {}^1\Sigma$. The Λ-type doubling in the $^1\pi$ state is found to be negligible.

The principal molecular constants obtained are as follows (Cm^{-1}) units):

$F\ {}^1\pi$ State $T_e = 25285.30;$ $B_e = 0.1608;$ $\alpha_e = 9.1 \times 10^{-4}$

$\omega_e = 384.94;$ $\omega_e X_e = 1.65$

$X\ {}^1\Sigma$ State $B_e = 0.1765;$ $\alpha_e = 10.0 \times 10^{-4};$ $D_o = 1.3 \times 10^{-7};$

$\omega_e = 415.29;$ $\omega_e X_e = 1.58$

10. On the Optical Absorption Spectra of $Ni^{2+} . 6H_2O$ Complex in Crystals

R. Chatterjee, Calcutta

The ligand field theory is applied to explain the optical absorption spectra of Ni^{2+} complex ion. To explain all the bands and lines of Ni^{2+} ion, an orthorhombic field superposed on cubic field is assumed. Calculation of the energy matrix for d^8 electron configuration in cubic field is performed by means of Tanabe and Sugano's method. A good agreement is obtained between our theoretical results with the experimental results of Hartmann and Muller (1958) which the latter authors themselves could not fully explain. Moreover, we have worked out a complete theory of the susceptibility and magnetic anisotropy of Ni^{2+} ion in an orthorhombic field and found good agreement with the experimental values, using the cubic and orthorhombic field parameters same as in case of optical absorption.

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11. A Modification of the R-K-R Method of Constructing the 'True' Potential Energy Curves of Diatomic Molecules

N. L. SINGH and D. C. JAIN, Varanasi

A modification of the R-K-R method of constructing the 'true' potential energy curves of diatomic molecules has been suggested which simplifies the numerical work involved in the calculations to some extent. Following the method by Vanderslice, Mason, Maisch and Lippincott (1959, a) of introducing artificial discontinuities in the law of force, an artificial discontinuity is assumed at each vibrational level. The values of $(w_e)_i$ and $(w_ex_e)_i$ are determined by solving the quadratic equations involving these and the corresponding vibrational terms, instead of the least square technique applied by them.

The method has been applied for calculating the 'true' potential energy curve of $C^3\pi_u$ state of N_2 molecule and it is found that the results compare well with the values obtained by Vanderslice, Mason and Lippincott (1959, b) which justifies the procedure adopted by us.

REFERENCES

Vanderslice, J. T., Mason, E. A., Maisch, W. G. and Lippincott, E. R., 1959, a, J. Mol. Spectroscopy, **3**, 17.

Vanderslice, J. T., Mason, E. A. and Lippincott, E. R., 1959, b, J. Chem. Phys., **30**, 129.

12. On the Absorption Spectrum of *m*-Chlorophenol Vapour

N. L. SINGH and B. R. DAS, Varanasi

The absorption spectrum of *m*-chlorophenol in vapour state has been studied in detail. The spectrum lies in the region 2800–2550 Å and consists of more than 200 bands which have been analysed in terms of 4 ground state and 12 excited state frequencies. The results are found to agree well with known Raman data.

13. On the Emission Spectrum of *p*-Tolunitrile

N. L. SINGH and R. N. SINGH, Varanasi

The near ultra-violet emission spectrum of *p*-tolunitrile was obtained by means of an uncondensed transformer discharge through flowering vapour of the substance. The whole spectrum consists of nearly 21 bands in the region 2755–3150 Å superposed on a continuum beginning at about 2760 Å and extending to beyond 3800 Å with maximum intensity in the middle portion of the spectrum. A tentative vibrational analysis of the spectrum is proposed in terms of four ground state frequencies. Except one, the rest three suggested ground state frequencies find support from the Raman data.

14. On Fluorescence Spectrum of Phenol Vapour

N. L. SINGH and SATYA PRAKASH, Varanasi

The near ultra-violet fluorescence spectrum of Phenol vapour has been obtained of the Hilger Medium Quartz Spectrograph. It consists of nearly 70 bands with a weak continuum superposed over the entire spectrum. The exciting source had been a condensed iron spark. A tentative analysis is made on the basis of fundamental ground state vibrations 241, 526, 624, 812, 828, 1001, 1256 and 1598. These agree well with Raman data.

15. On the Emission Spectrum of Aniline

R. J. Singh, Varanasi

The emission spectrum of aniline has been obtained in an uncondensed transformer discharge through the flowing vapour of the substance. There are nearly 130 bands in the region (2859 Å–3255 Å) superposed on a continiuum starting from about 2800 Å and extending upto 4000 Å. The observed ground state frequencies of 235, 378, 528, 621, 826, 994 and 1031 cm^{-1} are correlated with the symmetric Raman frequencies 234, 386, 534, 615, 817, 994, 1030 cm^{-1} respectively. Excited state frequencies 62, 291, 340, 493 cm^{-1} have been obtained as also observed by Ginsberg and Matsen[2] in their absorption work.

A detailed analysis will be published elsewhere.

16. Near U.V. Absorption Spectra of 1,4,-Naphthoquinone

R. S. Singh and S. C. Srivastava, Varanasi

The absorption spectra of 1,4-Naphthoquinone in vapour phase has been studied in the near ultraviolet region with a view to study the perturbation in the quinonoid ring caused by the fused benzene ring. Various cell lengths at various temperatures were tried. With a cell of 100 cms at 105°C and a cell of 50 cms at 95°C two systems, one in the 3000–3500 Å region and the other in the 2250–2500 Å, develop respectively. Both systems appear to be due to allowed $(\pi-\pi)$ electronic transition from the gross structure of the bands, the 0,0 of the two systems being at 29404 cm^{-1} and 40599 cm^{-1} respectively.

As a result of the present investigation it is found that one of the transitions which should have been forbidden becomes allowed on account of the perturbation caused by the benzene ring. The definite assignments of the transition should await further work both theoretically and experimentally.

17. Intensity Measurements in Bands and Rotational Temperatures

M. I. Savadatti and N. T. Tawde, Dharwar

Rotational temperatures for OH$(\overset{2}{\Sigma}-\overset{2}{\pi})$, excited in the inner cones of methyl alcohol/air flames have been measured at various air/fuel ratios of combustible mixture. At these air/fuel ratios, intensity of OH (0–0) at the R_1 head (B) was measured simultaneously with the corresponding integrated intensity (A). The ratio A/B was found to follow the rotational temperature (T) of OH. Further the graph of log (A/B) plotted against 1/T gave a straight line. This relationship is discussed with regard to the correction to be applied to band head intensities.

18. Studies in Nitrogen Afterglow

B. G. JYOTI and N. R. TAWDE, Dharwar

Nitrogen afterglow was produced by passing a condensed discharge through nitrogen. Intensities of (a) the afterglow and of (b) the discharge are measured by varying (1) the pressure of N_2, (2) the rate of flow of N_2 and (3) the voltage at which the discharge is maintained. It is found that while the intensity of the afterglow is proportional to the cube of the pressure, that of the discharge proper decreases as logarithm of pressure. The effect of rate of flow on intensity of the discharge is similar to the effect of pressure, whereas the same on the intensity of the afterglow is somewhat different from that of pressure. As voltage is increased the afterglow intensity increases, passes through a maximum and then begins to decrease, whereas the discharge intensity continuously increases with voltage.

The afterglow is characterised by selection of the IP bands of N_2 and the discharge by the N_2 IP, IIP and the First negative (N_2^+) bands. The first negative (N_2^+) bands have been found to be more intense in a discharge through flowing gas than through trapped gas. It is also observed that N_2^+ bands in the flowing gas condition gain brightness with increasing pressure and rate of flow. However, such is not the case with IP and IIP. Their behaviour is contrary. With voltage increase all the bands of the discharge gain in intensity. These observations are discussed in the light of the mechanism of the nitrogen afterglow.

19. The Oscillator Strength and Transition Probabilities of the Schumann-Runge System of O_2

N. SRREEDHARA MURTHY, Dharwar

The transition probabilities for the Schumann-Runge system of O_2 recently measured by Treanor and Wurster have been used to obtain an expression for the variation of electronic transition moment with inter-nuclear separation. With the use of this relation a new estimate of the oscillator strength has been made and critically discussed in terms of the available *f*-data for the system.

20. Saturation Curves for KCl : Tl Luminescence

R. V. JOSHI, Baroda

The saturation curves for U.V. and visible luminescence were studied in the case of KCl : Tl phosphors. The results obtained indicate that there is difference in the filling up of the ultraviolet and visible traps. This difference can be explained if Tl^+ centres responsible for ultraviolet and visible emission are assumed to be different.

21. Effects of Reactor Radiations on Optical Spectra of Caesium Uranyl Nitrate and Uranyl Nitrate-hexahydrate

R. M. DIXIT, Bombay

The effects of reactor radiations on optical spectra of caesium uranyl nitrate and uranyl nitrate hexahydrate are studied. The spectra of the three hour irradiated caesium salt indicate absence of the characteristic absorption and fluorescence of UO_2^{++} ion. Instead of fluorescence a new set of bands appears which closely resembles a portion of UO_2^{++} spectrum in hexahydrated uranyl nitrate.

A set of bands which are attributable to the impurity in caesium salt get particularly enhanced in irradiation.

Uranyl nitrate hexahydrate shows no change in its spectra after irradiation for a period of one hour.

22. An Observation in maximising the Output of a Crystal Detector in Microwave Measurements

P. C. Mahendru and R. Parshad, New Delhi

It has been observed that the pick-up by a crystal detector housed in a detector mount under matched conditions (i.e., about unity standing wave ratio) is a function of the placing of the crystal in the detector mount. As the crystal is displaced, maxima and minima of detected output appear. The difference between the two power levels is about three *db*.

The above fact can be made use of in obtaining increased sensitivity in microwave measurements.

The exact cause of the effect observed is not clear, but phenomenologically it appears that the crystal mounting inside the wave-guide system produces higher order modes which alter the straight TE_{01} field (at the crystal itself) to a varying electric field along the crystal length, and at right angles to the broad face of the wave-guide. The placing of the point contact of the crystal with respect to this field variation would determine relative magnitude of the power output.

23. Absorption of Microwaves of 3cm Wave-length in Anisole and its Solutions

T. J. Bhattacharyya and K. K. Deb, Calcutta

The absorption of microwaves of wave length 3 cm in pure anisole and its solutions of different concentrations in CCl_4 and hexane have been studied. The pure liquid shows the maximum absorption at 4°C and in the case of solutions in CCl_4 or hexane the maximum of absorption is found to occur at lower temperatures. The radius of the rotor as calculated from the Debye's formula was found to be 1.65 Å approximately and it has been pointed out that the OCH_3 group may be identified as the rotor in the present case.

Soild State Physics and Crystalography

24. Structure of Etch Pits on Calcite

A. R. Patel and K. N. Goswami, Vallabh Vidyanagar

Calcite cleavages are etched with citric acid. Careful observations have revealed that though the individual isolated pits have the same shape and size, their structures differ. Approximately boat shaped pits having their 'keel' rectilinear and having their 'keel' bent in one direction or the other at the nose and thus having different structures, are observed. The bent 'keel' gives the appearance of a 'beak'. By etching matched cleavage faces with the same etchant and with different etchants it has been established that pits of one structure on one face correspond to pits of the same structure on the matched face. It has also been shown that structures described above persist on continued etching. The dynamic etching of calcite cleavages in addition to the usual pits and the pits of the above structures have revealed the pits of terraced structures. These terraced pits are found to have point as well as flat bottoms. Correspondence of the terraced pits on matched faces has been established. It is shown that the method of etch has nothing to do with the terracing of the pits. From the persistance of the structures of the pits on continued etching and their matching on oppositely matched cleavage faces when etched with different etchant, it is conjectured that the different structures may be attributed to different nature of defects in the crystal lattice at which such pits are nucleated.

25. Etching of Synthetic Mica

Dr. A. R. Patel and S. Ramanathan, Vallabh Vidyanagar

The etch patterns produced by hydrofluoric acid on synthetic mica have been studied optically. It consists of only localised individual isolated pits. The usual random distribution of small micropits observed on natural micas along with the individual isolated pits are not observed in the present investigation and this may be attributed due to the absence of impurity atoms in the lattice of the crystal. It is observed that the shape, size and orientation of the pits is not uniform throughout the pattern and this may be attributed due to the inhomogeneous structure of the crystal face. By etching oppositely matched cleavage faces one to one correspondence between the localization of the individual isolated pits has been established. Thin flakes of mica have been etched. It has been shown that considerable amount of correspondence exists in the etch patterns on the opposite faces of a thin flake. The etch patterns on the opposite faces show a considerable amount of displacement which is not uniform throughout the pattern. The displacement has been explained by postulating the existence of included linear dislocations in the body of the crystal. The implications are discussed. On some samples triangular pits are observed having basal extension. These basal extensions are shown to be air wedges within the body of the crystal.

26. Etch-pits in crystals and dislocations

G. C. Triguhnayat, Delhi

The result of delicate etching with water vapour upon cadmium iodide crystals exhibiting growth spirals on their surfaces are described and discussed. The creation of very symmetrical small hexagonal pits lends strong support to the idea that etch-pits are preferentially formed at the sites of dislocations, and thus justifies the use of etching techniques in revealing boundaries of dislocations on crystal surfaces in the study of problems of plastic deformation. A tentative explanation for how the presence of a dislocation induces a local dissolution of the crystal, is suggested on the basis of the fact that the strain energy of lattice is high around a dislocation.

27. Optical Study on Cleavage and Etched Survfaces of Fluorite

J. R. Pandya and N. S. Pandya, Baroda

Freshly cleaved surfaces of Fluorite are examined and then etched with various acids. The surface examination is done with high resolution microscopy and multiple beam interferometry. Triangular etch pits oriented differently which turn into block patterns on prolonged etching have been observed. The cleavage lines shift and the pits remain stationary. The crystal plates were bent and then etched. The results are discussed on the movement of dislocations.

28. Hysteresis Loop Tracer for the Study of Ferromagnetic Properties over wide Ranges of Temperature

A. K. Mukherjee and N. G. Sutradhar, Calcutta

Quite a number of semi-conducting samples obtained from natural sources or prepared artificially are found to be ferromagnetic. With a view to study the role of the free electrons responsible for semi-conduction on the ferro-magnetic behaviour of such samples, a 50 c.p.s. hysteresis loop tracer has been designed which enables us to study single crystals of these samples at different temperatures both high and low.

Here the sample placed in an a.c. magnetic field induces a voltage, in a previously balanced pick up coil surrounding it, proportional to the rate of variation of the intrinsic induction in the sample. Another coil placed in the same field H picks up a voltage proportional to dH/dt. Both are suitably amplified, integrated and fed into the oscilloscope to get the desired pattern.

Measurements can be made of intrinsic coercive force, residual induction of the sample, the normal permeability and the normal induction and can be studied with respect to the field.

29. A Method of obtaining True Values of Electrical and Magnetic Properties of perfect Graphite Crystals from a Study of these with Defective Ones

R. Bhattacharya, Calcutta

It has been shown from X-ray observations that in all natural crystals of graphite, descrete misalignments between the different crystals blocks are inevitably present and these are further enhanced by the purificatory treatments which are usually undertaken before the actual measurements of any of its electronic properties. It has also been shown that above-mentioned enhancement of the defects produce appreciable change in its electrical and magnetic properties. None of the existing measurements of these properties which are with purified natural crystals of graphite therefore represent the true values for perfect crystals and hence can be discussed in relation to any of the proposed theories. From a measurement of the variation of intensity along the extension of the X-ray spots observed in a rotation photograph, a method has been suggested with which the above-mentioned true values can be obtained. The present paper gives an account of these,

30. Setting up of a Paramagnetic Resonance Spectrometer for the Study of Magnetic Behaviour of Crystals

U. S. GHOSE and R. N. BAGCHI, Calcutta

For various studies on magnetic behaviour and structure of crystals, a paramagnetic resonance spectrometer is considered to be one of the most important tools. A transmission type electron paramagnetic resonance spectrometer operating at 3.2 cm wavelength has been set up in this laboratory. For study at different temperatures a cryostat has been designed by us to suit the purpose of varying the temperature down to well below 90°K. Arrangements have been made for investigations along different axes of a single crystal. In order to measure the magnetic field as accurately as possible, a proton resonance fluxmeter designed mostly after Knoeble and Hahn has been constructed. The apparatus has been standardised with D.P.P.H.

Theoretical investigations on the susceptibility, g-values and the nature of crystalline electric fields of Fe^{++}, Ti^{+++}, Co^{++}, V^{+++} and Ni^{++} have been carried on by Bose, Chakravarty and Chatterjee of this laboratory. The resonance spectrometer will enable us to test many of the conclusions, derived in their theoretical investigations. X-irradiated single crystals of alkalihalides having defect centres (e.g., KCl containing TlCl) have been prepared in this laboratory by S. Dutta. Nature and concentration of colour centres and g-values of such crystals can also be studied with this spectrometer. Fairly detailed account of the apparatus is presented.

31. Dielectric Behaviour of Some Bentonites

SM. SABITA GHOSH, Calcutta

The dielectric behaviour of some bentonites of different sources was studied for frequencies ranging from 100 Kc/S to 4 Mc/s. The Bentonites from Germany (Hanover) and England and from Assam, Kashmir and Rajasthan in India were taken in powder form and sieved through 200 mesh per sq. inch. The samples are packed between brass electrodes of the experimental condenser. The loss-tangent (tan δ), ε'', ε' and relaxation time τ were then measured within the said frequency range with the help of a precision type Q-meter. In the tan δ vs. frequency and ε'' vs. frequency curves for all the studied samples, maxima were observed. The values of the relaxation time (τ) were determined from tan δ vs. frequency curves by the relation $\tau = \frac{1}{2\pi f_{max}}$. The observed values of the frequency for maximum absorption and the computed values of the relaxation time for the different samples of Bentonite were as follows :

Sources	f_{max}(Kc/S)	τ(Second)
Germany (Hanover)	240.0	6.6×10^{-4}
England	167.0	9.5×10^{-4}
Assam	240.0	6.6×10^{-4}
Kashmir	240.0	6.6×10^{-4}
Rajasthan	300.0	5.3×10^{-4}

The method of measurements and the experimental results are discussed.

32. Effect of Assymmetry of Shape on the Magnetic Anisotropy of Crystals

Manju Mazumdar, Calcutta

In order to eliminate the effects of asymmetry of shape of magnetically anisotropic crystals, particularly those with low anisotropy, cylinders (or spheres) are usually ground out of the crystals—a procedure open to objection in case of hygroscopic or deliquescent crystals, and generally, because of the possibility of contamination. Efforts were, therefore, made to estimate the shape effects and apply them in the case of actual crystals which could then be used in their natural form.

In order to correct for the shape effects, isotropic crystals of several alums and alkali halides (which have no magnetic anisotropy of their own) were chosen and rectangular plates of different dimensions, l, b, and h [where l = length, b = breadth and h = height when the plate is suspended vertically in any particular experiment] were ground, using a crystal grinding apparatus set up for the purpose. The plates were suspended with different edges vertical and the apparent magnetic anisotropy $\Delta\chi/\chi$ (χ-being the magnetic susceptibility) determined with the help of an improved form of apparatus based on the well-known Krishnan method. The results indicate some interesting relationship between $\Delta\chi/\chi$ and l, b and h, for example, $\Delta\chi/\chi$ increases with decreasing b; l and h remaining constant, and $\Delta\chi/\chi$ becomes zero for $l = b$. Again $\Delta\chi/\chi$ decreases with increasing, h, l and b remaining constant, and becomes zero for $h \rightarrow \infty$.

From the observed results and by graphical interpolation it is possible to apply suitable correction terms within certain experimental limits for normally available crystals.

33. Surface Self-Diffusion of Iodide Ions in Films Adsorbed on Metals

H. J. Arnikar and **O. P. Mehta**, Varanasi

Characteristic discontinuities and sudden 'downpours' observed in the time-rate of adsorption of *labelled* I^- ions on metals and marked deviations from the effective partition coefficient ratio in its adsorption from a two phase (water-CCl_4) adsorbate system, showed the occurrence of measurable surface mobility in the adsorbed layers. Results are reported for the measurement of surface self-diffusion coefficient (D*) of I^- ions for its uni-dimensional diffusion in mono- and multilayers of the adatoms under conditions of zero concentration gradient of the total I^- (labelled and unlabelled). Data are presented for D* for I^- ions on copper and aluminium for various temperatures in the range 150–250°C. The faster surface diffusion in multi-compared with mono-layers is discussed in terms of corresponding entropy and heat of activation.

34. Temperature Variation of the Absolute Photoelastic Constants of Potassium Chloride and Potassium Bromide

K. V. Krishna Rao and **V. G. Krishna Murty**, Hyderabad

This paper describes a method of studying the temperature variation of the absolute photoelastic constants of cubic crystals. The method consists in evaluating the differential stress-optical constants by Filon's method, the ratio of the strain-optical constants by an ultrasonic method and combining these data to obtain the absolute strain-optical constants. A number of cubic crystals have been studied by this method in the temperature range 30°C to 400°C. The results for potassium chloride and potassium bromide are reported here. It has been found that P_{11} and P_{12} for both potassium chloride and potassium bromide and P_{44} for potassium bromide first increase with the rise of temperature and then decrease whereas p_{44} for potassium chloride steadily increases with temperature.

35. Mixed Layer Mica-Vermiculite-Chlorite Structures

BIBHUTI MUKHERJEE, Calcutta

Gruner's idea of the distortion of structural planes of vermiculite by grinding for unsatisfactory powder photographs has been found untenable in the present investigation. The lattice dimensions of a true vermiculite from Ajmer-Marwar were determined as, $a_0 = 5.24 \pm 0.02$ Å, $b_0 = 9.17 \pm 0.02$ Å, $c_0 = 28.60 \pm 0.05$ Å, $\beta = 94°36' \pm 24'$, the monoclinic angle being slightly larger than the angle obtained by Hendricks and Jefferson. The intensity relations between the different reflections in the powder photographs of this typical vermiculite are in good agreement with the relative values of structure factors determined by Hendricks *et al.*

Large groups of vermiculite layers and small groups of mica layers occur as distinct units along with hydrobiotite units in some specimens of vermiculite, but the specific mutual orientation of the adjacent layers of mica is not evident. The proportion of layers in the mixed vermiculite-mica, determined from the graphs of Brown and MacEwan (1951), may be expressed as an interstratification of alternate layers of units of vermiculite and mica, and of three units of vermiculite with two units of mica making up a large part of the specimens. The stronger reflection of hydrobiotite (001_y) compared to (008) of vermiculite and (006) of mica has been attributed to the change of phase between reflections from successive layers of the larger units of this mixed structure.

Interstratification of layers of units of vermiculite and chlorite in almost monomolecular layers with the probable reflection of this mixed structure, and more complex mixed-layer structures of vermiculite-chlorite and *K*-saturated vermiculite have been discussed.

36. Tentative Molecular Structure of Tetramethyl Diphosphine Disulphide

S. N. DUTTA, Lucknow

In view of the recent interest in the chemistry of Organophosphorous Compounds, the structural investigation of Tetraethyl diphosphine disulphide was undertaken as an extension of the study on Tetraethyl diphosphine disulphide (see Dutta, S. N. and Woolfson, M. M., Acta Cryst., **14**, 178, 1961).

Crystals of $(CH_3)_4P_2S_2$ were in the form of colourless needles (m.p. 205–13°). Oscillation and Weissenberg photographs showed the unit cell to be monoclinic with the following dimensions :—

$$a = 19.20, \quad b = 10.88, \quad c = 7.00\ \text{Å}; \quad \beta = 94.5°$$

The crystals were invariably twinned across the plate face (100). The space group is somewhat ambiguous; it is either *C*2, *Cm*, or *C*2/*m* and contains **6** molecules per unit cell. However, the $hk0$ reflexions showed a very distinctive feature : reflexion types $hk0$ vanished unless $h = 3n$ where n is an integer. This implied that for the [001] projection, the pseudo-cell was effectively a third of the real cell and at the same time centered.

A partially sharpened Patterson synthesis was employed for finding a rough picture of the plausible 'molecular motif'. The interpretation of the Patterson map, supplemented by a simplified fly's eye procedure, gave the molecule a *trans* -form. With this trial model the structure factors were evaluated to obtain the likely phases; the latter were then employed to obtain the electron density distribution for the [001] projection. An examination of the resulting Fourier map showed that, for a first map, the peak resolution and heights were resonably satisfactory. The over all structure factor agreement was fairly good; the agreement residual at this stage was 25% (including the accidental absences as well). Although the complete structure has not been unravelled so far, the preliminary X-ray analysis seems to suggest that the molecule of $(CH_3)_4P_2S_2$ has a *trans*-form and is probably centrosymmetrical.

37. X-ray Powder analysis of Diphenylamine

J. DHAR and S. N. MITRA, Dhanbad

The diphenylamine crystal was studied by the well-known powder method of analysis. The observed spacings of the lines in the powder photograph were found in close agreement with the spacings calculated on the basis of the cell-dimensions reported earlier.

38. Small angle X-ray measurements on Alkali treated Nagel keratin

DR. T. RATHO, Cuttack

The small angle scattering camera after Kratky capable of high pefreession measurements was used in the present investigation on Keratin treated as a densely packed phaser system. The sample was irradiated with copper $k\alpha$ radiation obtained from a Siemen's apparatus by the well known crystal monochromator after Jahanson Guinier. The scattering curve was obtained photographically and following the procedure of Guinier the radius of inertia of the crossection and the thickness factor were obtained from the Log $(Im)-m^2$ and the Log $(Im^2)-m^2$ curves rsespectively. However for the calculation of radius of inertia the scattering elements were treated as road like particles and for the estimation of the thickness factor they are taken as thin sheats. The curve representing the Guinier plotting for the crossections factor breaks up distinctly into two parts leading to two values of the radius of inertia as 26 Å and 78.5 Å respectively. Similarly the thickness factor curve gives 36 Å and 115 Å as the values for the thickness factor. It is thus seen that a new smallest layer of thickness 36 Å which is exactly half the smallest layer of 72 Å reported previously by Dr. Skoda and others is obtained.

39. An X-ray Study of Fluoranthene

J. DHAR and S. N. MITRA, Dhanbad

The fluoranthene crystals were studied by the rotating-crystal as well as by the powder methods of analysis. The X-ray study of the fluoranthene crystal by the powder method supports Krishnan and Banerjee in their view-point that the crystal data given in Groth's Chemishe Krystallographie under fluoranthene refer to the compound $C_{16}H_{10}$.

From the X-ray measurements the cell-dimensions of the fluoranthene crystal were obtained as $a = 18.41$ Å; $b = 6.22$ Å; $c = 37.89$ Å and $\beta = 97°42'$. Hence the axial ratio is 2.959 : 1 : 6.091. The number of molecules per unit cell comes out to be 16.

40. Changes in Crystal Structure of $Cu[NH_4SO_4]_2\ 6H_2O$ with Temperature

Gouri Bhowmik, Calcutta

Thermal dehydration curve of $Cu(NH_4SO_4)_2 6H_2O$ showed three distinct steps at 65°C, 110°C and 158°C corresponding to loss of 4, $1\frac{1}{2}$ and $\frac{1}{2}$ molecules of water respectively per formula unit. X-ray powder photographs of the first two dehydrated phases were taken, and the crystal structure determined. It is found that the monoclinic $Cu(NH_4SO_4)_2 6H_2O$ first changes to an orthorhombic dihydrate form at 65°C, then to a monoclinic hemihydrate at 110°C, and finally to the anhydrous phase whose structure is yet to be determined.

41. A Method of Determining the Nature of the Intensity Distribution in Power Diffraction lines

G. B. Mitra and N. C. Halder, Kharagpur

Careful experimental investigation has shown that the intensity distribution in powder diffraction lines is more or less of a Gaussian form. But it has not been possible to determine whether it is of the Gauss or Cauchy type or a combination of both. On the other hand, the importance of such knowledge in particle size determination for instance is immense. In the present work it has been shown that although the experimental line profile can not be made to fit in with a function $p(z)$ where $p(z)$ is either the Gauss or Cauchy or a convolution of the two, because the difference between numerical curves describing them is too slight to be distinguished, a function $N(z) = \int_0^z p(z)dz$ gives quite distinguishable results. Analytical forms of $N(z)$ for the three cases have been derived. A method of experimental determination of $M(Z)$ has been described.

Gas and Ionic Theory etc.

42. Theory and Performance of Thermal Diffusion Column

S. C. Saxena and S. Raman, Bombay

A general theory of thermal diffusion column filled with the isotopes of a monatomic gas and interacting according to an inverse power model is developed. The theory of Furry and Jones valid for maxwellian gas molecules follow as a particular case of the present work. The available experimental column data are compared with the predicted values of this theory. Recent calculations of Mc Inteer and Reisfeld valid for molecules which interact according to the familiar Lennard-Jones (12–6) potential are also considered. In general, only a poor quantitative agreement is obtained between theory and experiment. The theory also completely fails in its present form for isotopes of polyatomic gases and for binary mixtures. It, however, successfully predicts a qualitative form for the pressure dependence of the over-all separation factor in a thermal diffusion column.

43. Thermal diffusion of Binary Gas Mixtures. II

S. C. Saxena and S. M. Dave, Bombay

Rigorous theoretical formulas according to Chapman and Cowling, and Kihara approximation schemes have been derived for the Thermal diffusion factor of such binary mixtures where the lighter component is in trace.

These formulas are further simplified by expanding in powers of the ratio of molecular masses. The latter expressions are simpler and preferable for numerical computation. Sample numerical calculations reveal that the convergence of the theoretical formulas for this case is poorer as compared to the other end of the composition range, the magnitude depends upon the system and on the temperature range.

44. Equilibrium Properties of Polar Gases. I. Second Virial Coefficient

S. C. Saxena and K. M. Joshi, Bombay

The theoretical expressions for the second virial coefficient, $B(T)$, are derived from the (18-6-3) Stockmayer potential

$$\phi(r) = 4\varepsilon \left[\left(\frac{\sigma}{r}\right)^{18} - \left(\frac{\sigma}{r}\right)^{6}\right] - \frac{\mu^2}{r^3}\, g(\theta_1, \theta_2, \phi),$$

where $g\ (\theta_2, \theta_2, \phi) = 2\ \mathrm{Cos}\,\theta_1\ \mathrm{Cos}\,\theta_2 - \mathrm{Sin}\,\theta_1\ \mathrm{Sin}\,\theta_2 \mathrm{Cos}\,\phi$. and also according to the (28-7-3) potential. Reduced virial coefficient is tabulated for the former potential. The experimental data of $B(T)$ are interpreted for a number of gases. The potential parameters are reasonable and reproduce the $B(T)$ data within the limits of experimental errors. The point dipole polarizable model is also considered.

45. Two Body Correlation Function in Gases

S. L. Deo and B. Deo, Cuttack

Starting with the exact equations of kinetic theory for distribution functions and treating inverse density and potential as perturbations, it is found that all many particle distribution functions can be generated by a one particle distribution function and a two body correlation function. It is further noted that even in the zeroeth order of approximation, the correlation function has a non-vanishing value. This is explicitely evaluated for a Maxwellian distribution function and is found to be oscillatory for some two body potentials.

46. 'Correlationless' Kinetic Equation for Gases

R. K. **Satpadhy**, Bhubaneswar

An equation very much similar to Plasma equation without collision is deduced from the general kinetic equation under some approximation for neutral gas molecules. This equation is studied to obtain oscillatory solution. It is found that there exists solutions usually under Landau damping. A special distribution function is used to calculate exactly the velocity of propagation and Landau damping. An application to a delta function potential is also made. Typical conditions for growing waves and decaying waves and for infinity and zero damping cases are considered.

47. Study of Ionised Gases by a Radiofrequency Probe

S. N. **Sen** and A. K. **Ghosh**, Calcutta

A radio frequency signal (frequency 2.2 Mc/Sec) has been used as a probe to investigate the characteristics of an electrical discharge in air and in mercury vapour the discharge being excited by a transformer. An alternative method has been employed to measure the radio-frequency conductivity of the ionized gas at various pressures of the gas from 5×10^{-3} mm to 1 mm of Hg and also for various values to the discharge current. The variation of conductivity with pressure conforms to the theoretical deduction and various parameters such as electron concentration per unit volume, the random velocity and the electron temperature have been calculated. The variation of conductivity with discharge current shows that rise of electron concentration with current is not strictly linear and attains a saturation value when the current exceeds a certain minimum value determined by the pressure at which the observation is being carried out.

48. Influence of Ionic Currents on Heat-transfer in Liquids

R. G. **Edkie**, R. D. **Rao** and D. V. **Gogate**, Baroda

The phenomenon of heat transfer between an electrically heated wire and a liquid in which the wire is placed is studied and the variation of heat transfer coefficient with change in the value of $\Delta\tau$ (excess of temperature of the wire over that of the surrounding liquid) is determined. Ionic currents are then produced in the liquid by means of electrolytic dissociation and their effect on heat transfer is carefully noted. It is found that the value of heat transfer coefficient undergoes peculiar variations with regular increase in the strength of the ionic current. A detailed investigation of the changes in the heat transfer coefficient with change in the strength of the ionic current is described.

49. Effect of Irradiation on the Peak and Average value of the Current in an Electrodeless Discharge

M. G. **Kelkar**, Amravati

Observations of the effect of irradiation with visible light on the peak and average value of the current in an ozoniser discharge, containing air at low pressure (2–10 m.m.Hg.) are reported. It is observed that $\%\Delta i$ is maximum in both cases at the threshold potential *Vm.* (r.m.s. value of the breakdown voltage). Its magnitude, however, is large in the peak current and is perceptible in the entire potential range investigated. ($\sim$3 to 4 times *Vm*). In the average current the effect becomes insignificant at high potentials.

The results are explained on the basis of the oscillographic observation of the preferential suppression of the first large current pulse in each half cycle on irradiation. The progressive decrease of $\% \Delta i$ in the peak value is due to a corresponding reduction in the "active time interval" (when light is effective in its action of removing some of the loosely bound electrons from the momentary cathode) between successive half cycles. Since the smaller pulses are not affected by light $\% \Delta i$ in the average value of the current is small and almost vanishes with considerable increase in their number at higher potentials.

50. Heat of Mixing and Ultrasonic Velocity in Liquid Binary Mixtures

Prof. S. K. K. Jatkar and M. V. Kaulgud, Poona

The negative velocity deviations in eighteen polar in non-polar binary mixtures have been correlated with heat of mixing using the Hildebrand' solubility parameter equation. For a given polar solute in different nonpolar media the velocity deviation is more, the more the difference in solubility parameters of the components. For different polar solutes in a given solvent the velocity deviations decrease the more the difference in solubility parameters.

51. Measurement of the Thermal Conductivity of Chemically Reacting Gas Mixtures

P. K. Chakraborti, Calcutta

The thermal conductivity of dissociating N_2O_4 involving both the reactons $N_2O_4 \leftrightarrows 2NO_2$ and $2NO_2 \leftrightarrows 2NO + O_2$ has been measured between 100°C and 200°C and below a pressure of one atmosphere, using the absolute hot wire method. The results are, however, generally not in good agreement with the values calculated on the assumption of local chemical equilibrium. Various reasons for this discrepancy have been discussed.

52. Studies on Mutual Diffusion of Polar-nonpolar Gax Mixtures

B. N. Srivastava and I. B. Srivastava, Calcutta

The two-bulb technique of Ney and Armistead was employed for the measurement of the diffusion coefficients of mixtures of ammonia with argon and krypton in the temperature range $-20°C$ to $60°C$. Diffusion was allowed to take place through a precision capillary tube connecting the two diffusion bulbs and a previously calibrated thermal conductivity analyser was used for analysing the gas samples at different times.

A least square method was followed for determining the unlike interaction parameters from the experimental D_{12} values at different temperatures, on the Lennard-Jones (12 : 6) potential, The combination rules for such systems and the force constants of pure components were also used for calculating the unlike interaction parameters. Both the sets of parameters were used for calculating the diffusion coefficients. A comparison between the observed and calculated D_{12} values indicates that the combination rules for polar-nonpolar interactions are reasonably satisfactory but not quite exact.

Meteorology Ionosphere

53. Further Observations on Dew and their Significance

B. Padmanabhamurty and V. P. Subrahmanya, Waltair

The influence of various meteorological factors responsible for the deposition, maintenance and dissipation of dew was studied. Occurrence of dew is seen to bear a consistently close relation to the depression of radiation—minimum temperature below dew-point—greater dew deposited as the difference increased. Curves showing hourly variation of dew and the influencing meteorological parameters clearly indicate an inverse relation between dew on the one hand and vapour pressure and wind speed on the other. The net outgoing radiation slightly increases until the time of dew formation when the latent heat released due to condensation reduces nocturnal cooling of the surface and in turn the net out-going radiation. Figures representing vapour pressure profiiles on particular dew nights show the development of vapour pressure inversions or constancies following the onset of dew.

A comparative study of dew observations at Waltair and Poona shows that Waltair has maximum frequency of dew in winter while Poona records its maximum in autumn. Further, Waltair (coastal) is seen to register higher annual dew amounts than Poona (Hill) although Poona should record higher values according to Rosenan and Gilead. The topography and interior location of Poona are perhaps not able to counteract the low humidities of the winter air for greater dew deposits in this season.

Curves depicting the march of mean monthly number of dew nights and mean monthly dew amounts at the above two stations indicate the differences in their dew regime. They also point to the conclusion that at Waltair the maximum amount of monthly dew occurs in the month of maximum frequency of dew occurrence while at Poona the peaks show clear separation indicating that Poona has large number of dew nights with sparse amounts of dew.

54. Scattering of Light Signals in Foggy Weather

W. J. John, Kanpur

This paper discusses the apparent change in the colour of light signals in foggy weather due to scattering. Rayleigh's and Mie's theory of scattering by small particles are briefly discussed. The scattering coefficient varies as λ^n where $n = -4$ for particles much less than the wave length of light and it goes up to even $+2$ for water droplets of 2–3 μ size. The available data for the observed values of n for fogs vary from 0.3 to 1.3 generally.

The spectrophotometric curves of several blue green and red signal glasses have been studied. The paper discusses quantitatively the apparent change of colour of these glasses due to the colour temperature of the source and also due to scattering following Mie's theory outlines above. The maximum variation in colours and dominant wave length for $n = 1$ and $n = 2$ have been calculated and discussed.

The usual statement that the red signals should contain no shorter wave lengths whatever even to a small percentage is not borne out from the above calculations.

55. The Refractive Index and the Absorption Index of the Ionosphere

Y. S. N. Murty, Delhi and S. R. Khastgir, Calcutta

In the present paper, simple expressions for the refractive index and the absorption index of the Ionosphere have been obtained with the help of the expressions for the polarization parameters obtained earlier by the authors. To illustrate the application of the expressions, a set of values of the refractive index and the absorption index have been computed under specified conditions.

56. A Note on the Group Refractive Index of the Ionosphere for zero Collisional Frequency

S. R. Khastgir, Calcutta and Y. S. N. Murty, Delhi

In a previous paper (Jour. Atoms. & Terr. Physics, London. **21**, 65, 1961) Murty and Khastgir obtained a general expression for the group refractive index of the ionosphere following the Appleton–Hartree formulae. In a recent paper by Unz (Jour. Atoms. & Terr. Physics, London, **20**, 189, 1961) an expression was also worked out for zero collisional frequency. On obtaining the expression for the group refractive index of the ionosphere for zero collisions from our general expression, it is found that the expression is not the same as that given by Unz. In the present communication, attention has been directed to an algebraic misrepresentation in Unz's paper which is responsible for the difference in the expressions for the group refractive index of the ionosphere for zero collisional frequency obtained by us and by Unz.

Theoretical Physics

57. Mass Spectrum from Four-Boson Contact Interaction

B. Deo, Cuttack

Following the analysis of Nambu for four-fermion interactions an attempt is made to explore the possibility of a mass spectrum for a self-coupled complex scalar or pseudoscalar boson (spin zero) field. It is found that starting with a self-mass equation, self-consistency requires that there can be a bound state of zero mass only if a momentum dependent vertex function exists. The ratio of the cut-off mass to self-mass and the self-coupling parameter can then be uniquely fixed. The existence of this particle is assumed and the strength of its coupling with the massive particle is determined. All couplings turn out to be large.

It is further noted that there are two conditions for resonance scattering of mesons. They can be explained by assuming the existence of two highly unstable particles, 2.1 and 3.3 times heavier than the scattering particle. If the scattered particles are pions the above particles have masses round 565 and 995 electron masses. The existence of such particles have been postulated by many workers from time to time.

58. Response Function of a Degenerate Electron Gas

P. Misra and D. Misra, Cuttack

The electrical behaviour of a homogeneous electron gas is best described by the "Response function" $K(\vec{\mathbf{k}}\omega)$ defined by the relation $J_\alpha(\vec{\mathbf{k}}\omega) = K_\alpha\beta\vec{\mathbf{k}}\omega)\ E\beta(\vec{\mathbf{k}}\omega)$ which in space-time configuration becomes a non-local and a-causal relation $J_\alpha(\vec{\mathbf{r}}-t) = \int d\vec{\mathbf{r}}' \int_{-\infty}^{+\infty} dt'\ K_\alpha\beta(\vec{\mathbf{r}}-\vec{\mathbf{r}}',t-t')E\beta(\vec{\mathbf{r}}'\ t')$ J and E being the current density and electric field respecstively and J and E their Fourier transforms. This function is analogous to the inverse of "Impedance" in electric circuits and determines how an electrical disturbance propagates in the electron gas and under what circumstances the disturbance becomes oscillatory. The expression for the energy loss and scattering of charged particles involve this response function. For these reasons the function is a very important parameter for an electron gas. So far, this function has been evaluated for an electron gas at absolute zero temperature. In this paper we have evaluated this function at temperatures in the neighbourhood of absolute zero temperature by using the Boltzman-Vlassov equations and Fermi-Dirac distribution law of electron energies. Causality condition has been invoked on $K_\alpha\beta(\vec{\mathbf{r}}-\vec{\mathbf{r}},t-t')$ to make the current-Electric field relation causal. Conditions under which the electrical disturbance become oscillatory are discussed. It is found that these conditions are the dispersion formulae for the Plasma oscillations of the electron gas.

59. Unstable particle in a Soluble Relativisticq Quantum field theory

T. Pradhan, Cuttack

In the derivative coupling $(L' = \lambda\psi(x)r\mu\ \psi(x)\delta_\mu\ \phi(x))$ relativistic quantum field theory explicitly solved by the author[1] the Boson becomes unstable and decays into a Fermion-anti Fermion pair if its mass is greater than twice the Fermion mass. The formalism adopted for the stable particle case treated in reference[1] is not adequate under this circumstance and requires modification. The modified formalism is presented from which a self-consistent equation for the complex decay constant is obtained, the real part of which gives mass renormalisation and the immaginary part gives the decay constant.

60. Elastic Scattering of Fast Protons by Deformed Nucleus

N. C. Sil and S. K. Dutta, Calcutta

Recent experimental evidences such as the energy levels in rotational spectra and electric quadrupole moment, etc., indicate that the heavy nuclei in the region far removed from the closed shell configuration possess an appreciable spheroidal deformation. This deformation is expected to have a bearing on the results where the effect of nuclear shape plays an important role; in this paper we propose to investigate that effect on the nuclear scattering. Here the elastic scattering cross section for fast protons by a semi-transparent, prolate spheroidal nucleus has been calculated after neglecting the effect of nuclear spin interaction. It is assumed that the electrostatic field of the nucleus is generated by a uniform distribution of electric charge within the nucleus. Apart from the coulomb potential (between the proton and the nucleus) there is a nuclear interaction which is represented by an optical model complex rectangular well potential with constant depth and sharp cut-off at the nuclear boundary. The elastic scattering amplitude is calculated by the Born approximation method. The case of 96 Mev proton scattering by tantalum ($A = 171$, $Z = 73$) has been numerically computed since it is found that tantalum has a large value of electric quadrupole moment and hence possesses an appreciable prolate spheroidal deformation. The computed results agree well with the experimental data.

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[1] Proceedings of the Elementary Particles and High Energy Physics Symposium, New Delhi, December 1960.

Proceedings of the Indian Science Congress Association, Roorkee, January 1961.

61. Dependence of Møller Scattering on Initial and Final Polarisations of Electrons

D. Basu and S. Sarkar, Calcutta

A general expression has been derived for the Møller scattering of electrons in which the polarisation states of both the initial and final electrons are arbitrary. In a way we have generalised the expressions given by Ford and Mullin for the two special cases of (i) the variation of differential scattering cross section irrespective of polarisation on the nature of polarisation of the two initial electrons, and (ii) the variation of the nature of polarisation of one of the scattered electrons when one of the initial electron is longitudinally polarised and the other initial electron unpolarised. To have better understanding of the results the general expression which is very lengthy may be very much simplified if we consider special cases. In the centre of mass system we take the initial electrons to be polarised perpendicular to the plane of scattering and the final electrons to be longitudinally polarised, it is found that in the limit of very high energy of the electrons, the differential scattering cross section consists of terms depending on the initial polarisations, final polarisations and both, the term that depends on both the initial and final polarisations vanishes for $\theta = 0°$ and $90°$. We have also obtained a term proportional to the fourth power of mass in addition to the terms obtained by Ford and Mullin for the case when the initial electrons are arbitrarily polarised and the scattered electrons are unpolarised.

62. The Quantum Nature of Charge

Dharani Dhar Das, Cuttack

An attempt has been made to give an explanation of the quantization of electric charge. It is well known that electric charges have quantum nature. A simple and semi-classical approach has been made to prove it. The proof is qualitative and non-rigorous. Electric charge 'q' will have electromagnetic field around it. The energy of this electromagnetic field is found out to be $\frac{q^2}{a}$ where 'a' is the radius of the charge. Since energy is quantized, it follows that charge should also be quantized. Since charge is a point and "radius of the charge" is rather meaningless, we interprete the radius as the uncertainty in the localization of the static charge. We proceed to associate a minimum momentum of the charge. By using de-Broglie relation one deduces that the charge $q = \pm n\sqrt{\hbar C_0}$ where n is an integer, $\hbar$ = Plank's constant/2π and C_0 = a constant introduced here which may be called "the charge constant". The positive minimum value of q is $\sqrt{\hbar C_0}$. From an appeal to the experiment one gets Co $= \frac{e2}{\hbar} = \frac{C}{137} =$ velocity of light multiplied by the finestructure constant.

63. Lattice Thermal Conductivity at Low Temperatures

BAL KRISHNA AGARWAL and G. S. VERMA, Allahabad

The theoretical models of Callaway and Klemens are compared to the experimental results in (a) Silicon and Diamond, (b) Solidified Argon and Neon and (c) KCl and NaF. The three sources of scattering are postulated; phonon-phonon processes, isotopic point defect scattering and boundary scattering except in NaG where isotopic scattering is absent. Callaway model, in all cases, gives good fit and an excellent agreement is obtained for Diamond and solidified Argon and Neon. Casimir model for finding out the characteristic length for the boundary scattering fails to explain the observed results in solidified Argon and Neon. This indicates the existence of microscale fluctuations in the composition of the solid. In NaF the characteristic length has to be decreased by a factor of about five. For Diamond the value of the parameter A, which gives the best fit with the expriment, is hundred times the value calculated from Klemens expression for A. Good agreement with the experimental results beyond the conductivity maximum is obtained by taking (B_1+B_2) to be temperature independent.

64. Linear and Antilinear Transformations of the Dirac Wave Function for Massless Particles under Conformal Coordinate Transformations

N. C. RASTOGI, Lucknow

Explicit expressions are given for the transformations of the wave function ψ when a relativistic conformal transformation of the coordinates is made. The possibility of antilinear transformations, which mix the original and the charge conjugate wave functions, is taken into account.

65. Electromagnetic Field of a Charged Particle in uniformly Accelerated Motion

VACHASPATI and SUDARSHAN L. PUNHANI, Lucknow

A uniformly accelerated charge particle is peculiar in that it gives rise, at any given space-time point, *either* to a retarded *or* to an advanced electromagnetic field, but not to *both*. On general grounds one expects both kinds of fields to exist at all space-time points. The mathematical reason why only one kind of field exists in the case of uniform acceleration is pointed out and a limiting procedure is introduced to overcome the difficulty. It is then possible to obtain *both* kinds of fields at *all* points excepting the boundaries of some regions. The field at these boundaries can be determined by requiring that it should eliminate the presence of any unphysical charges. The solutions at these boundaries are not unique, contradicting a statement of Fulton and Rohrlich (1960) to this effect. Explicit expressions for the potentials and the fields are given. Our results partly confirm those of Bondi and Gold (1955).

66. Design of a Small Scale N-15 Column Assembly

D. GUPTA*, M. N. NAYAK*, Bombay

One of the most useful applications of the Squared off Cascade calculations lies in the determination of minimum column volumes for small scale production of stable isotopes based on the process of distillation, chemical exchange or exchange distillation. The minimum plant volume of an N-15 column assembly has been calculated based on the process of chemical exchange between NO and NHO_3 by using three different procedures developed in this laboratory. The design of the product refluxer has also been discussed briefly.

67. Various Approximation for the Isotopic Thermal Diffusion Factor. II. Application to Hydrogen Isotopes

S. C. SAXENA and P. A. PARDESHI, Bombay

Numerical calculations are performed for the thermal diffusion factor of hydrogen isotopes in conjunction with the various theoretical formulae. New formulae are derived for the two limiting concentrations for the binary mixtures. These formulae are further simplified by expanding in terms of the reduced mass, and also as riatio of the two molecular masses. The accuracies of these approximate formulae are estimated by comparison against the rigorous formulae for several interesting binary mixtures of hydrogen isotopes. Approximate calculations are done to estimate the quantum corrections.

68. Multicomponent Diffusion in System Kr^{85}-He-Kr

B. N. SRIVASTAVA and R. PAUL, Calcutta

The diffusion coefficients of Kr^{85} in trace quantities in mixtures of helium and normal krypton, as well as in pure helium and pure krypton, have been determined by using an all-metal apparatus. The apparatus consists of two diffusion chambers connected by a diffusion capillary of special design so that it can be opened or closed by a piston operated by a metal valve fitted with bellows. For analysis one of the chambers has a thin cellophene window with a scintillation counter placed close to it. First both the chambers were filled with the desired gas mixture and then a small amount of Kr^{85} was added to one chamber and the pressure equalised. Diffusion was then started and counting rate determined at regular intervals, from which the relaxation time and the diffusion coefficient were calculated. The diffusion coefficient

$\mathscr{D}_{1\to 23}$ of Kr^{85} in the mixture of krypton and helium was found to be accurately given by the theoretically predicted formula

$$\frac{1}{\mathscr{D}_{1\to 23}} = \frac{C}{\mathscr{D}_{22}} + \frac{C_3}{\mathscr{D}_{23}}$$

where C_2, C_1 are the concentrations of normal krypton and helium and $\mathscr{D}_{23}$ the binary diffusion coefficient. As expected a plot of $1/\mathscr{D}_{1\to 23}$ against C_2 was found to be a straight line.

69. Knight Shifts in the Intermetallic Compound $PtSn_2$

S. S. Dharmatti, V. Udaya Shankar Rao and R. Vijayaraghavan
Bombay

Nuclear magnetic resonances of Pt^{195} and $Sn^{117,119}$ have been observed in the intermetallic compound $PtSn_2$. The Knight shift of Pt in $PtSn_2$ is negative and 0.16% in magnitude. Sn in $PtSn_2$ shows a positive Knight shift of 1.06%. Knight shift of Pt is interesting because in the pure metal it has a large negative Knight shift (−3.52%). The results are discussed from the point of view of exchange polarization of the inner *s*-shell electrons by the *d*-band electrons. Knight shifts in similar alloys will be reported.

70. Levels in Sb^{119}

R. K. Gupta, R. Srinavasa Raghavan, G. C. Pramila and S. R. Amtey
Bombay

The radiations from 5 day Te^{119m} ($11/2^-$) and 16 hour Te^{119} ($\frac{1}{2}^+$) have been investigated by scintillation techniques on the expectation that both the low spin and high spin excited states of Sb^{119} will be populated in these decays. The gamma-rays of 153, 270, 930, 950, 1000, 1100, 1220 and 2100 kev from the decay of Te^{119m} and gamma-rays of 645 and 1760 kev from the decay Te^{119} have been detected. The summing and coincidence spectra show levels at 270, 645, 1220, 1370, 2290 and 2370 kev. A $g_{7/2}$ assignment for 270 kev level, expected from the systematics of $g_{7/2}$ levels in odd antimoney isotopes, agrees with experimental data.

71. Decay of Se^{75}

J. Varma and M. A. Eswaran, Bombay

The decay of 120 Se^{75} has been investigated employing NaI(Tl) scintillation spectrometer and coincidence technique. The intensities of the electron capture transitions to the 403,572 and 628 Kev states as of As^{75} are found to be in the ratio of $1 : 5.3 \times 10^{-4} : 2.4 : 10^{-4}$. On the basis of log ft values of the β- and electron capture transitions the orbitals of the 477, 572, 628 and 814 Kev states of As^{75} are estimated as $1/2^-$, $5/2^-$, $1/2^-$ and 5/2 (or 7/2) respectively.

72. Radiocarbon from Nuclear Reactors

P. Abraham and S. D. Soman, Bombay

Carbon-14 is one of the hazardous isotopes produced in nuclear reactors and by nuclear weapons tests. In nuclear reactors carbon-14 is produced by one of the following processes. (i) $N^{14}(n,p)\ C^{14}$, (ii) $O^{17}(n,\alpha)\ C^{14}$ and (iii) $C^{13}(n,\gamma)\ C^{14}$. The quantity of carbon-14 produced by these different reactions in Canada India Reactor at Trombay has been calculated. The radiocarbon in the gaseous effluent, at the point of release from CIR, is estimated to be only 1/25 of the maximum permissible concentration. The concentration of carbon-14 at ground level is insignificant.

The CIR, the total quantity of radiocarbon produced in the air, is 28.5 millicuries per day or 10.5 curies per year. In the primary cooling water, the rate of production of carbon-14 is 110 millicuries per year and in heavy water, the amount is 2.7 curies per year.

A relation is arrived at to estimate the amount of argon-41 produced in the effluent of any air-cooled reactor, knowing the quantity of carbon-14 produced.

73. Monitoring of Iodine-131 in Air using Activated Charcoal

S. K. Mehta and P. Kotrappa, Bombay

I-131 absorption efficiency of activated charcoal has been examined for the purpose of routine I-131 monitoring in air. A standard cartridge consisting of 14–22 mesh size charcoal in a 1½ inch long glass tube of ½ inch diameter has been designed for sampling I–131 from air. The standard cartridge picks up I–131 with an efficiency of 98 per cent and can be easily counted in a well-type scientillation counter. Air activity of 0.005 mpc can be detected in a 20 minute sample taken with 40 lit/min pump and higher activities in proportionately shorter time.

Some interesting observations on filter paper sampling are also reported herein.

74. Estimation of Tritium in Aqueous Samples

S. D. Soman. T. S. Iyengar, S. H. Sadarangani and P. K. Vaze, Bombay

The paper describes the construction, operation and standardization details of a gas phase counting system employed for the estimation of very soft beta emitters. The apparatus is being used for the estimation of tritium levels in the heavy water samples from various projects in Atomic Energy Establishment Trombay and urine samples of personnel working with tritium.

Hydrogen-tritium mixture is extracted from the test sample by reducing it with calcium at room temperature. This is dried and adapted for internal counting in a G. M. counter. The counter uses Burshane as quenching gas and has a plateau of 160 volts. The apparatus was standardised and the linearity in response over a wide range was established. Specific activity of tritium as low as 2×10^{-3} uc/ml could be estimated with the apparatus.

The paper also discusses the advantages of gas phase counting over other methods.

75. Activation of Impurities in the Pool Water of the 'Apsara' Reactor

D. V. Gopinath, Bombay

The coolant water in reactors builds up radioactivity due to neutron irradiation of its constituents. An exact theoretical evaluation of such activity build-up involves parameters which are sometimes difficult to determine. In this paper is given a comparative study of the calculations of activity build-up made on simplified assumptions and the experimental values.

Water samples from the demineralising plant and the pool of the 'Apsara' reactor were irradiated for different times and at different power levels. The composite gamma-decay characteristics of these samples were calculated and compared with the experimental gamma-decay characteristics. It appears from this study that the radioactivity from any impurities not given in chemical analysis data or from the fast neutron reactions with coolant constituents is negligible after 15 minutes of cooling.

76. Temperature Build-up in Gamma Active Sphere

V. K. Sundaram, D. V. Gopinath and A. K. Ganguly, Bombay

One of the ultimate methods proposed for high level radioactive waste disposal is to contain the activity in ceramic bodies and bury them underground or in the deep sea. The limit of the activity that can be incorporated in such bodies is decided by the temperature rise in the body due to the absorption of nuclear radiation. The present paper discusses the temperature distribution in a solid sphere incorporating long lived gamma emitters and buried in a medium having the same thermal properties. Temperature build-up with time for MeV and steady state temperatures for 0.5, 1, 2 and 3 MeV gamma rays have been calculated at the centre and surface of a 20 cm radius sphere. The results are compared with the temperature distribution in a sphere containing long lived beta emitters. It is observed that the temperature rise due to the gamma emitters is about 75% of that due to a beta emitter of the same maximum energy.

77. Radiation Levels around CIR Primary Coolant System

T. N. Krishnamurthi, Bombay

In this paper is given a theoretical evaluation of the radioactivity build-up in the primary coolant water of Canada-India Reactor and the gamma field at different points on the surface and around the delay loop, located outside the reactor. The characteristics of the prominent impurities in the coolant water, their activity build-up under neutron irradiation, radiation dose due to these activities at different points of the loop, are presented in tables. These tables can be made use of for any easy computation of radiation levels near the delay pipe for different concentrations of the coolant water impurities.

78. Inelastic Scattering of Gamma Rays by Bound Electrons

J. Varma and M. A. Eswaran, Bombay

The inelastic scattering of the 662 Kev gamma rays from Cs^{137}, by the tightly bound *K*-shell electrons of lead has been studied employing sodium iodide counters and coincidence technique. After eleminating the interferring effects it is found that, unlike in the case of Compton effect, the scattered gamma rays have a broad energy distribution. The scattering cross-section is estimated to be much smaller than that reported by previous workers. The various effects which interfere with these measurements would be discussed.

79. Preparation of Eu^{156} and $\mathrm{Gd}^{116},{}^{149}$ by Ion Exchange at room temperature

A. T. RANE, Bombay

Very high specific activity isotopes of Eu^{156} and $\mathrm{Gd}^{146,149}$ were produced and purified from their targets by ion exchange separation using Dowex 50 resin (80–120) mesh size) and lactic acid as eluant, at room temperature, 28°C.

About 50 mgs. of enriched Sm^{154} (99%) were irradiated with high flux of neutrons in DIDO, Harwell. The Eu^{156} was formed thus :

$\mathrm{Sm}^{154}(n,\gamma)\ \mathrm{Sm}^{155}\xrightarrow{\beta} \mathrm{Eu}^{155}\ (n,\ \gamma)\ \mathrm{Eu}^{156}$, $t_{\frac{1}{2}} = 15.4\mathrm{d}$. Sm^{153} was simultaneously produced by reaction $\mathrm{Sm}^{152}\ (n,p)\ \mathrm{Sm}^{153}$, $t_{\frac{1}{2}} = 47$ h.

In another sample about 100 mgs. of ordinary europium were bombarded with 110 Mev proton beam. Gd^{146} and Gd^{149} were produced thus,

$\mathrm{Eu}^{151}(p,6n)\ \mathrm{Gd}^{146}\xrightarrow{\mathrm{Ec}} \mathrm{Eu}^{146}$ $t_{\frac{1}{2}} = 38$ h. and $\mathrm{Eu}^{151}\ (p,3n)\ \mathrm{Gd}^{149}\xrightarrow[t_{\frac{1}{2}}=9.3d]{\mathrm{Ec}} \mathrm{Eu}^{149}$, $t_{\frac{1}{2}}=120\mathrm{d}$.

Both $\mathrm{Gd}^{146,149}$ and Eu were separated from their targets using ion exchange column of 18.5 cm in height and 1.6 cm in diameter. The pH of the lactic acid used was 3.45 in the case of $\mathrm{Gd}^{146,149}$ and 3.53 in the case of Eu^{156}. The activities were examined by a scintillation counter and the elution curve showed a clean separation in the case of Gd–Eu and slight cross-contamination persisted in the case of Eu-Sm. The radiochemical purity was ascertained by examining the gamma ray spectrum of the separated fractions. The time required for both the separations was about 24 hours.

80. Low Energy Scattering of Electron by Variational Method

S. C. MUKHERJEE, Calcutta

In this paper the cross section of elastic scattering of electron by helium atom is calculated with allowance for exchange effect. The wave equation for this three body problem contains a term for the potential to which the incoming electron is subjected. the potential is evaluated by taking the ground state wave function of helium atom of the form of Taylor and Parr (1952). Then the phases are calculated from the differential equation obtained by the variational method of Hulthen (1944). When k. the electron wave number in atomic units, is 1.053, the value of the total scattering cross section becomes $3.39\pi a_0^2$. the exchange effect is neglected. this result compares favourably with that of Moiseiwitsch (1953) who obtains $4.18\ \pi a_0^2$ for the same with the simpler wave function of Hylleraas. If exchange effect is taken into consideration the cross section for this energy is found by Moiseiwitsch to be $3.25\ \pi a_0^2$.

81. An investigation of the ^{7}Li (d,n) ^{8}Be Nuclear reaction using the Photographic Emulsion Technique

J. P. Sah, Lucknow

The energy levels of ^{8}Be have been studied by means of the ^{7}Li (d,n) ^{8}Be reaction using deuterons of energy 635 Kev. Photographic emulsions have been used as neutron detectors.

Evidence of levels in ^{8}Be was found at 2.9 and 10.4 Mev. The angular distribution of neutrons from this reaction has also been investigated.

The various modes of the reaction $^7\mathrm{Li}+d$ have been considered and the proportion of the total disintegrations corresponding to the formation of ^{8}Be in the ground or any of the excited states has been inferred.

82. On the Mass Determination of Σ-Hyperons and *K*-Meson

P. C. Mathur, Delhi

The mass of Σ^+ —hyperson has been determined using $\Sigma^+ \rightarrow P + \pi^0$ decays at rest in a well calibrated stack, exposed to a magnetically separated enriched K^- -meson beam from Bevatron. The stopping powers of the stack relative to standard emulsion is determined by measuring the μ-meson ranges from $\mu-\theta-e$ events. The thickness of each pellicle was measured before exposure and the shrinkage factor is therefore known to an accuracy of 1%. The masses of Σ–hyperson and K^- -meson are determined by the analysis of collinear events, resulting from interactions of K^-–mesons with the free Hydrogen nuclei. The following mass values are obtained :—

$$M_{\Sigma^+} = (1189.8 \pm 0.5) \text{ Mev}$$

$$M_{\Sigma^-} = (1196.8 \pm 0.8) \text{ Mev}$$

$$M_{K^-} = (494.5 \pm 0.7) \text{ Mev}$$

$$M_{\Sigma^-} - M_{\Sigma^+} = (7.0 \pm 0.7) \text{ Mev}$$

The Σ^-, Σ^+ mass difference is independent of the accurate knowledge of the stopping power of the stack and is found by iteraction method. The mass value of the *K*–meson, obtained by this analysis, compares well with the mass value (492.8±1.5) Mev obtained by the analysis of τ^--decay in flight in this stack.

The Σ-hyperons were produced by the capture of $K-$mesons in the emulsion nuclei.

83. Life-time and Asymmetries in Σ-Hyperson Decays

B. Bhowmik, G. R. Gupta, P. C. Jain, P. C. Mathur and
N. T. Venkata Lakshmi, Delhi

The mean life-times of charged Σ-hypersons decaying via π^+ and π^- modes have been determined by maximum likelihood method. The charge of the hypersons have been determined by following the decay pions or the pions from the parent star. The following life-time estimates are obtained

$$\tau\,(\Sigma^{+}_{\pi^{+}}) = (0.89\,{}^{+\infty}_{-0.50})\;10^{-10}\ \text{sec.}$$

$$\tau\,(\Sigma^{-}_{\pi^{-}}) = (1.35\,{}^{+9.75}_{-0.63})\;10^{-10}\ \text{sec.}$$

considering the total sample, consisting of identified positive and negative hyperon decays as well as unidentified $\Sigma^{+}_{\pi^{+}}$ decays we get

$$\tau\,(\Sigma^{+}_{\pi\pm}) = (1.08\,{}^{+0.81}_{-0.33}) \times 10^{-10}\ \text{sec.}$$

a value intermediate between lifetime of Σ^+ and Σ^- hypersons. The so called anomaly regarding life-time of the mixture of Σ^+ decays which appeared to be even lower than the life-time of individual charged mode in earlier work is therefore unfounded. The effects of systematic and statistical errors on the determination of lifetime are discussed.

The lifetime of Σ^+-hyperson decaying via proton mode is determined by rest +fight method as well as by maximum likelihood method and is found to be in good agreement with each other. The values of lifetime obtained are

$$\tau\,(\Sigma_{p}^{+})_{p+R} = (0.98\,{}^{+0.42}_{-0.36}) \times 10^{-10}\ \text{sec.}$$

$$\tau\,(\Sigma_{p}^{+})_{p} = (0.96\,{}^{+1.46}_{-0.36}) \times 10^{-10}\ \text{sec.}$$

Up down asymmetries of the decay products of Σ-hypersons are determined with respect to the plane of production. No asymmetry is found within experimental errors.

The Σ-hypersons were produced by the capture of K-mesons in a G_5 emulsion stack exposed to an artificially produced enriched beam.

84. Concerning Fore-Aft Asymmetry in Λ°-Decay

B. Bhowmik, D. P. Goyal and N. K. Yamdgni, Delhi

A sample of Λ^0-hyperons identified by Q-value estimation has been used to study fore-aft asymmetry in the decay of the Λ^0-hyperon. From the consideration of the energy spectrum of Λ^0-hyperons the fraction produced by (a) strong interactions $K^- + N \rightarrow \Lambda^0 + \pi$, $\Sigma + N \rightarrow \Lambda^0 + N$; and (b) radiative decay $\Sigma^0 \rightarrow \Lambda^0 + \gamma$ have been separated. In the sample (a) the observed value of $\alpha\bar{P} = 0.23 \pm 0.24$ and $N_f/N_b = 25/27$, which is consistent with an isotropic distribution. For sample (b), the distribution is asymmetric and $\alpha\bar{P} = 1.12 \pm 0.27$ and $N_f/N_b = 33/9$. Thus Λ^0-hyperons produced by radiative decay display longitudinal polarisation, as expected. A scanning procedure has been adopted which eliminates any possible contribution of spurious fore-aft asymmetry due to scanning bias.

85. Leptonic decay rates of hyperons

B. BHOWMIK, Delhi

The first examples of leptonic decays of Σ and Δ^0-hypersons in nuclear emulsion have been observed in our experiment. Only one example of $\Sigma^- \rightarrow n+e^-+v$ and two examples of $\Lambda^0 \rightarrow p+e^-+\bar{v}$ have been found. On the basis of these events our observed decay rate is consistent with the predicted rate according to Universal Fermi Interaction Theory. The rates obtained from bubble chamber data on the basis of $(2+n?)$ $\Sigma^{=}\beta$ decay and about 15 $\Lambda\beta^0$ decays are found to be an order of magnitude less than the predicted rate. The implication of these results are discussed.

Astrophysics

86. Internal Constitution of Cold Bodies

Y. SINGH, Roorkee and V. K. TEWARY, Delhi

The mass-radius relation and the density distribution of cold planetary bodies has been determined by incorporating Thomas Fermi Dirac equation of state into Kothari's theory of pressure ionization. The contributions of zero point energy of phonons, exchange interactions, and the correlation energy of the electrons have been explicity considered.

87. The Circularisation of Elliptical Orbit of a Small Bodies Revolving round their luminary

SHIVA KISHORE, Jullunder

Robertson and Poynting have shown that a small meteorite will be swept into the sun due to radiation from the sun. The author by taking the finite size of the meterorite had shown that it will start spinning, and Yarkovsky effect will also oprate and oppose Robertson Poynting effect and stabilise the orbit and it will not be swept into the sun.

In this paper the author has examined the combined effect of Yarkovsky effect and Robertson Poynting effect on an elliptical orbit and has shown that a force appears tending to circularise the orbit, its time contant being of the same order as that of pure Robertson Poynting effect, (i.e., in the absence of Yarkovsky effect.).

88. Condensation in C. Von Weizsacker vortex rings

SHIVA KISHORE, Jullunder

Weizsacker has postulated the evolution of planets from the small ball bearing vortexes between the main vortexes which form ring system, each ring having five vortexes. The ring being bigger and bigger in diameter with a factor of about two. The main vortexes being retrograde, the planet volution had to be postulated in the secondary ball bearing rings which have direct rotation. The assumption seems artificial to many scientists and hence is not universally accepted.

The author has treated the main vortexes as bodies immune to rochie forces and has shown that they are non-rotating bodies and seem to rotate retrograde because of revolution. The interaction between the vorexes is shown to produce condensation and shrinking of vortexes as well as direct rotation. Due to inter-action of the vortexes of the same ring, direct spin acceleration will produc till the spin period equals revolution period. For interaction between vortexes of different rings the direct spin acceleration lasts till interaction lasts. The development of high spin results from the condensation and shrinkage with evolution. The merger of the nucleus of the vortexes of one ring in the ultimate phase is also shown to prouduce direct rotation. The condensation of matter from intermediate regions on the protoplanet is also shown to produce direct rotation. The condensation on extreme planets is shown to produce highly elliptical orbits.

89. The Dynamic Configuration of Bodies Immune to Rochie Force

SHIVA KISHORE, Jullunder

In this paper it has been shown that an elliptical body with axis ratio 1 : 2 moving in an orbit having its minor axis along the line joining the body to the centre but not spinning in space is composed of particles moving in independant orbital motion and without any mutual gravitation among the particles and hence such a body is immune to Rochie forces. Such a body has to change its shape by compression and expansion of its axis and hence it must not have rigidity and should be gaseous, liquid, or composed of minute dust particles.

It has therefore been concluded that a body can evolve out of matter having density lower than given by Rochie. However, it will have to conform to the condition given above for its being immune to Rochie forces.

In light of this it is not necessary to assume density above a certain minima for the evolution of our planets round the sun, even on the strength of purely gravitational forces and neglecting cohesion chemical and other binding forces.

90. The Energy-momentum Tensor for an Interesting Gravitational Field

R. V. WAGH, Bombay

There have been several attempts to investigate the gravitational field of Isolated rotating masses. Bass and Pirani, Thirring and others considered the case of rotating masses and shown the resulting gravitational field, which leaves the pressure isotropic. It has been shown in the earlier note that the pressure remains isotropic to a first degree of approximation. It is established here that in the case of rotating masses introduced in a Galilean field the condition of isotropy is not satisfied in general.

The line element for this case has been taken as

$$ds^2 = -dr^2 - r^2 d\theta^2 - r^2 \sin^2\theta d\phi^2 + dt^2$$

along with, $v^1 = \frac{dr}{ds} = 0, \qquad v^2 = \frac{d\theta}{ds} = 0,$

$$v^3 = \frac{d\phi}{ds} \neq 0, \qquad v^4 = \frac{dt}{ds} \neq 0$$

$\frac{v^3}{v^4} = \Omega$ which is of the nature of an angular velocity. The solution in this case is found, giving $T_1^1 = T_2^2 = T_3^3 \neq 0$.

At $R = 0$, which is the centre of the system of rotating masses, the energy is found to be equal to Zero at the Time T.

91. Decay of Shock Waves in Stellar Atmosphere

M. S. Bhatnagar and R. S. Kushwaha, Delhi

The Brinkley-Kirkwood (1947) theory of propagation of shock waves is further developed for application to Astrophysics. So far it has not been possible mathemetically to taken into account the energy lost by radiation(which escapes into inter-stellar space). An estimate of this energy loss is made in the present note on the assumption that the gas first loses energy due to radiation behind the shock front at constant volume and then expands adiabatically to its original pressure. The radial velocity computed on this assumption for the β-Cephei star BW Vulpeculae is found to be in good agreement with the observations and also the time of decay of the shock wave is of the order of the observed time of variations of radial velocity.

92. Random Fragmentation in Star Formation in Globular Clusters

M. M. Gupta and R. S. Kushwaha, Delhi

The theory of random fragmentation is applied to the star formation in M 92 and M 3. It is assumed that the prestellar configuration has a homogenous density distribution of material. The fragmentation took place as a single event and the various stars have different rates of evolution depending upon the mass. Consequently at the present time they are found in various stages of evolution. From comparison of the theoretical mass distribution curve for fragments and the observed mass frequency curve of stars an estimate of the masses of the two presteller cloud oconfigurations have been made. These masses are found of the same order as those obtained from dynamical considerations.

93. Equilibrium Abundances of Stable Isotopes

Hira Lal Duorah, Delhi

Equilibrium distribution calculated on the basis of the analogue of Saha's ionization formula is examined with the recent nuclear masses and abundance data. It is found that up to $A = 92$, the abundance distribution can be well reproduced. The electron degeneracy which becomes important has also been considered for the region $A = 64–92$. The equilibrium temperature is found to be 6.5×10 degrees. The neutrality condition is taken to have been satisfied by protons, neutrons, electrons and alpha-particles. The presence of position is not considered. Through effects of the excited levels are neglected the differences between the even and odd nuclei are taken into account.

94. Convection Zones in Stellar Atmospheres

K. S. Krishna Swamy and R. S. Kushwaha, Delhi

In the following the evolution of stars to the cooler regions of giants in H–R diagram one has to fit up core solutions with the atmospheric solutions. For this essential parameter is the constant that joins the pressure and temperature at the end of ionisation zone. The distribution of this parameter in the H–R diagram has been studied by computing atmospheric models. The value of the constant of the adiabatic relation is found to be less for giants than for main sequence stars for the same spectral type. In the case of the sun, it is found that the convection zone extends to about 30% of the solar radius which is within the limits of the values obtained by other workers.

Instruments.

95. Preparation of Arbitrary Scales for Controlled Movements

V. Venkateswara Rao, Warangal

In some of the physical instruments, controlled movements with reproducibility of the settings are more essential than absolute measurements. In the case of large grating spectrographs, particularly mounted in the manner suggested by Eagle, controlled movements and precise resettings are necessary for the translation along the rails and rotation about the vertical axis of the grating carriage and the tilt of the plate holder on the sector.

For the arbitary scale attached to the vertical axis, the micrometer arrangement is prepared first. The micrometer screw of ½ mm. pitch carries a head (divided into 50 equal parts) which moves across a scale with ½ mm. divisions. The circular scale is graduated with reference to the travel of the micrometer screw such that each division on it, corresponds to 10 divisions of the screw scale. Any position of the grating about the vertical axis can be defined by the scales on the disc, the micrometer screw and the head.

Usually a worm and wormgear arrangement is incorporated for such rotations, but the gear assembly inevitably introduces back-lash and its consequent errors from which the present arrangement is free. The scale is sufficiently fine and it is possible to rotate the grating through 1/500 of a division on the disc directly and by 1/5000 of a division by estimation, which is, in practice, found to be sufficient for giving reproducible settings to the grating.

This principle can be adopted wherever an arbitrary circular scale is required.

96. A Linear Radio Frequency Field Intensity Meter

Dr. V. G. Kher and V. L. Lokre, Nagpur

The conventional signal strength meters have generally non-linear scale which is crowded at both the ends. Even the more complicated and costly commercial instruments employing electronically regulated power supply develop a tendency towards a zero drift after some use. For accurate study of radio signal intensities, a simple, linear and stable signal strength meter is constructed with components that are readily available in any laboratory. This instrument employs a modified cathode follower circuit. Overlapping ranges are provided in this meter enabling comparison of radings taken on successive ranges. The calibration curves are linear in the range of variation usually met with. For visual observations a suitable damped linear micro-ammeter of range 0–60 with 60 divisions on the dial in used as an indicator. For continuous photographic recording multiflex or any other similar galvanometer is used. This instrument measures radio frequency voltages from 5 micro volts to more than 1.5 volts. The accuracy of measurement of varying radio fields is less than 15% for visual observations and for recorded observations it is less than 10 per cent. This circuit can be easily modified for actuating a pen and ink recorded of any range. Such modification has also been carried out. This instrument can also be used as an R.F. micro volt meter.

97. The Proposed Logic for an Analog Data Sampling System

S. K. Basu and R. R. Nargundkar, Bombay

A logical set up is described for direct feeding of digitized analog data to a digital computer. The sampled data is loaded to a buffer register when it is ready, and then serially shifted into the machine by the sequencing unit. The machine interrogates the digitizer by a special order code. The sequence however, does not go further till the operation complete pulse from the digitizer comes. A stored subroutine interrogates the buffer register three times per cycle. Each time 4 bits of binary coded decimal data are ready into the Multiplier Quotient register and processed. During this reading in period, the buffer register is isolated from the digitizer which proceeds with the next set of data.

98. A Gray Code Generator

M. V. Pitke and S. V. Rangaswamy, Bombay

This paper first describes a straight forward method of generating an *n*-bit Gray Code (reflected-binary code) employing at least 'n' Flip-Flope and '2^n' n-input AND gates. A simplied method for generating the Gray Code which results in high circuit economy is given later. This *n*-bit Gray Code counter consists of 'n' scale-of-two counters and an equal number of modulo two adders.

99. Optimum Counting Time and Resolving Time Calculator

S. P. S. Khalsa and L. H. Peshori, Bombay

The paper describes the development of a calculator which is intended to ease the calculation of optimum counting time (or optimum number of counts) of the background and the background plus sample counting for a specified percentage standard statistical error in assay of radio active samples.

Graphs are drawn for the specified case when the background is considered relatively constant (i.e., when the counter is well shielded) and it is not necessary to repeat the background reading for each sample, background being taken only once with a considerably high accuracy. The graphs give the number of counts required for a predetermined accuracy when sample plus background and background ratio is approximately known.

The use of the calculator for the comparison of counters in respect of their total optimum counting time for a known background and sample counting rate, is given.

Calculation of different types of counting errors such as probable, standard, ninetenth, etc. may be also be made with the help of the calculator.

Provision is made to account for the counting losses due to the resolving time of detector or probe unit.

100. A New Design for Dekatron Drive

P. K. PATWARDHAN, Bombay

Dekatrons are finding increasing applications as counting devices, because of the simplicity of their operation, low cost and economy in terms of components and space requirements. Dekatrons are used as Display Elements in Multi-Channel Pulse Height Analysers. Such a design is economical and quite stable. A 100 Channel design incorporating, fast, GC10D dekatron display and with Dead Time comparable to Magnetic Core Storage type analysers has been described else where. Each channel store consists of the first dekatron operated on a Two Pulse Mode with 'gating'; followed by another dekatron driven by a new circuit, which is being described in this paper. The new design results in cutting down the capital and running cost, considering that only 9 components are required for the new circuit as against 16 required for the conventional drive. Two different Plug-in-unit designs for channel storage are discussed in this paper.

101. Further Studies on the Operational Characteristics of a Burshane Gas Flow Counter

C. H. PAREKH, Bombay

A gas flow counter making use of the commercial fuel 'Burshane' has been designed by the Electronics Division, Atomic Energy Establishment Trombay. The design and performance of this counter were described by the author in a paper presented to the forty eighth session of the Indian Science Congress at Roorkee. In the present paper the results of further studies on the operational characteristics of the counter are described. The threshold voltage for counting was found to reduce as the sourceanode distance was decreased. Studies of the effect of the anode loop diameter on the threshold voltage indicated an optimum loop size of 1.8 cm corresponding to a loop radius of 0.75 cm. A systematic analytical investigation of the phenomenon revealed that the optimum loop radius would be 0.94 cm. By constructing a counter which approached closer to the model used in the analytical study, a value of 0.89 cm was obtained in much better agreement with the calculated value. A flow counter making use of a disc anode gave no indication of any optimum size.

102. Analysis of Vibrations using a pair of Coarse Transmission Gratings

Gopala Menon Sreekantath and Karunakaran Nair K,
Trivandrum

An optical device consisting of a pair of exactly similar coarse transmission gratings having opaque and transparent elements of the same width $\Delta/2$, a collimator and a telescope with a photo-electric cell substituted in the place of the eye-piece, has been developed for the analysis of vibrations sustained or transient.

The gratings are held one behind the other at a distance, a small odd multiple of Δ^2/λ, where λ is the wavelength of the light illuminating the slit and the twice diffracted zero-order image of the slit narrowed to such a width that either a dark or bright interference band covers it completely, is formed on the photo-electric cell. The vibrations to be analysed are transmitted to one of the gratings so that it moves laterally relative to the other with a velocity V at any given instance, when electrical pulses of frequency and intensity proportional to V are generated. These pulses after amplification are recorded on a magnetic tape and the tape record is used leisurely to find out the frequency of the pulses at any instant. The device is particularly useful in determining the velocity of a shockwave as it advances.

SECTION OF CHEMISTRY

President :—PROF. R. P. MITRA, D.Sc., F.N.I.

Abstracts.

ANALYTICAL

1. Colorimetric estimation of cobalt as the thiocyanate complex—Part II. Use of tri-n-butyl phosphate as extractant for the complex.

M. R. VERMA and P. K. GUPTA, New Delhi.

The cobalt-thiocyanate or the—thiocyanate-2-picoline or acetone complex can be extracted from the aqueous solution by tri-n-butyl phosphate. The latter is uniformly blue in colour and has an absorption peak at 620 mμ. The solution obeys Beer's law and the optical density measurements can be made a basis for the estimation of cobalt over a fairly wide range of concentrations.

2. Colorimetric estimation of cobalt as the thiocyanate complex—Part I. Use of 2-picoline as the complexing agent in aqueous solutions.

M. R. VERMA and P. K. GUPTA, New Delhi.

A new system cobalt-thiocyanate—2-picoline has been investigated and it has been shown that at pH 9, the solution has a maximum absorption at 322 mμ. There is another peak at 620 mμ in the visible region of the absorption spectrum of the above system.

Optical density in the visible region obeys Beer's law and the solution is very stable. This can be made the basis of a colorimetric determination of cobalt.

3. Paper Chromatography of Fe^{++} and Fe^{+++}.

MOHSIN QURESHY and MISS IQBAL AKTAR, Aligarh.

Paper Chromatography of Fe^{++} and Fe^{+++} has been studied. HCl (4 M) : N-Butanol : Acetic acid : Acetone (1 : 1 : 1 : 1) gives the best results. The separation is good at pH values ranging from (2·25 – 3·95). The presence of Al^{+++} did not affect the separation significantly.

4. Spectrophotometric determination of metal ion concentration in Heavy metal Soaps.

RIZWANUL HAQUE and WAHID U. MALIK, Aligarh.

Solution of nickel, cobalt and copper soaps of myristic and palmitic acids in pyridine exhibit maxima at 650 mμ, 450 mμ and 675 mμ respectively. Working at these wave lengths it had been found possible to use spectro-photometric method for the estimation of small amount of the metals in the respective soaps.

5. Influence of acids and salts on the use of Mn (iii) as an oxidising titrant.

MOHD. AJMAL and WAHID U. Malik, Aligarh.

Manganic sulphate solution has been found to be a suitable oxidising titrant for the estimation of lower valence ions like Iron (ii) and Tin (ii), separately as well as in their mixtures. These results indicate that the presence of the hydrogen ions and anions (chloride in the case of $SnCl_2$ and sulphate in the case of Iron (ii)) appreciably increase the values of $\frac{\triangle E}{\triangle V}$ at the inflexion point. In the mixture of these two ions the inflexion for the stannous-stannic equilibrium was found to be much smaller than the ferrous-ferric equilibrium. The bright platinum electrode was found to give better results than the mercury electrode.

6. Determination of basicity of chrome liquors containing organic acids.

D. RAMASWAMY, MISS S. C. SUMATHI and Y. NAYUDAMMA, Madras.

Determination of basicity of chrome liquor by both Procter and Lehigh methods is subject to error when organic acids are present. Low basicity values and in some cases even negative values have been reported for sugar reduced liquor and other types of chrome liquors containing large amounts of organic acids. In the method that has been suggested, the organic acids together with any strong mineral acid are first removed by solvent extraction technique by extracting with tertiary amyl alcohol-n-butanol mixture. The basicity of the chrome liquor was then found out by Lehigh method. The method has been applied to some commercial chrome liquors and other prepared liquors and uniformly higher basicity values have been obtained.

7. "Volumetric estimation of iron in presence of Hydrochloric acid by Potassium Permanganate".

TARA CHANDRA GUPTA and ABANI K. BHATTACHARYA, Agra.

Ferrous ammonium sulphate has been volumetrically estimated against a standard solution of postassium permanganate in the presence of hydrochloric acid. The limiting concentration of hydrochloric acid permissible for the titration without affecting the accuracy of the results within ±0·5% has been determined. The estimations have been done in hydrochloric acid system by adding manganous sulphate, phosphoric acid and Reinhardt-Zimmermann reagent (Sulphuric acid, phosphoric acid and manganous sulphate), which is known to be the most effective preventive solution. The relative merit of manganous sulphate, phosphoric acid and their combination in the Reinhardt-Zimmermann reagent has been discussed.

8. Spectrophotometric determination of beryllium with 2-(3-carboxy-2-pyridylazo)-chromotropic acid (tri-sodium salt).

A. K. MAJUMDAR and A. B. CHATTERJEE, Calcutta.

Trisodium salt of (3-carboxy-2-pyridylazo-) chromotropic acid has been used for the colorimetric determination of micro-amounts of beryllium. The red-violet complex shows maximum absorption at 590 mμ and obeys Beer's law from 0·1 to ·2·0 p.p.m. of beryllium. However, the optimum concentration range has been found to be from 0·2 to 2 p.p.m. of beryllium, where the per cent relative error per 1%

absolute photometric error is 3·028. The sensitivity of the reaction per cm^2 is 0·0048γ Be. The composition of the complex in solution as determined by Job's method suggests a metal to reagent ratio of 3 :2 and its instability constant is as $9{\cdot}546 \times 10^{-6}$.

9. A Colorimetric method for the determination of procaine in solution in micro-quantities.

R. N. BHATTACHARYA, Calcutta.

During a study on the stability of procaine hydrochloride in solution a suitable method was developed for its determination in micro-quantities. The method consists of diazotisation of procaine with sodium nitrite and hydrochloric acid, removal of excess nitrous acid by reaction with urea, and coupling the diazotised compound with n-naphthyl-ethylene diamine hydrochloride.

The pink colour obtained was found to have maximum absorption at 545 mμ and was found to obey Beer's law between 1 μg and 6 μg. The $E^{1\ \text{per cent}}_{1\ \text{cm.}}$ value for the dye calculated in terms of procaine base was found to be 1608.

The colour formation can be used for identification of procaine on paper after paper electrophoresis in quantities up to 0·1 μg.

Conditions necessary for the best formation of colour, for its use in quantitative analysis and its stability have been given.

10. Separation of Aluminium from Iron by Ion-exchange.

A. N. CHOWDHURY and S. BANERJEE, Calcutta.

Al^{+3} forms a comparatively weak complex with versene EDG (Ethanolamine-diacetic acid) whereas Fe^{+3} EDG complex is a fairly stable one and anionic complex. The separation of Al^{+3} from Fe^{+3} can be carried out on a Dowex 50 column by passing the solution containing EDG adjusted to pH 2·5 to 4. The Dowex 50 should be in the ammonium form and conditioned to the pH of the solution by passing a 1% ammonium acetate solution adjusted to the pH of the solution with dil.HCl before the actual separation procedure.

The solution containing Fe^{+3} and Al^{+3} is treated with versene EDG and then adjusted to the proper pH and passed through the ion exchange resin column. Al^{+3} is retained in the ion-exchange column but Fe^{+3} passes in the effluent. The column is then washed with 1% EDG solution adjusted to pH 3·0 to remove any traces of iron exchanged in the column. Al retained in the ion exchange column is then washed out with 4N HCl and determined either as oxinate or by other conventional procedure.

Iron to aluminium ratio has been studied ranging from 0·5 to 50 and this procedure gives a clean separation.

Be^{+3} and UO_2^{+3} interfere as they are retained by the ion-exchange column under the same conditions. Interference due to Ti^{+2} can be avoided by adding H_2O_2 when titanium passes in the effluent.

11. A note on detection and identification of isomeric xylenols in the presence of one another.

M. R. VERMA, P. K. GUPTA and K. C. GROVER, New Delhi.

Spots of 2 :6-xylenol and 3 :6-xylenol and mixture of these were applied separately on the base line of filter paper coupled with diazotised Amino I-Acid and the spots developed with aqueous layer of 2% sodium carbonate iso-amyl alcohol solutions. The spots due to isomeric xylenols had Rf values reasonably apart and were different in colour. These could be resolved from a mixture.

12. Bis- Salicylaldehyde-ethylenediamine as an analytical Reagent—Estimation of Nickel.

B. R. SINGH and SATYA KUMAR, Nainital.

Nickel is quantitatively precipitated using Bis-Salicylaldehyde-ethylenediamine reagent in the pH range of 10·5—13·5. The complex is quite stable in ammonia, N caustic alkali and complexing agents as tartrate, citrate, iodide, fluoride, thiosulphate, thiourea, and triethanolamine. Using tartrate and ammonia, those ions which do not react with the reagent, are kept in solution. As^{+3}, Sb^{+3}, Sn^{+2}, Bi^{+3}, and Zn^{+2} remain in solution at a high pH, using tartrate and 0·1 N caustic alkali. As^{+3}, Sb^{+3}, and Sn^{+2} are also separated using fluoride as the masking agent. Fe^{+3} is separated by using triethanolamine as the complexing agent at a pH of 13·0. Hg^{+2} forms a soluble iodide complex and is thus separated from nickel. Cobalt upto 50 mg. can be separated from nickel (20 mg.) by converting to a stable cobaltamine by an excess of ammonia.

13. Estimation of copper and nickel by res-n-butyro-phenone oxime.

J. S. DAVE and A. R. PATEL, Baroda.

In continuation of our work on the analytical applications of the substituted ketoximes of resacetophenone (Curr. Science, *29,* 472 (1960); J. Sc. Ind. Res., *20B,* 81, 1961), we here present some of the investigations on the use of res-n-butyrophenone oxime as an analytical reagent for copper and nickel. It is observed that copper and nickel can be estimated quantitatively by this reagent to the accuracy of ± 0·3% and ± 0·5% respectively. Further work is in progress.

14. Separation of Silver from lead and mercury (I) by cation exchange chromatography.

S. M. KHOPKAR and A. K. DE, Calcutta.

Cation exchange chromatographic separation of silver from lead and mercury (I) was accomplished by making use of organic solvent eluents on Dowex 50W-X8 in the hydrogen form. The various eluting agents used consisted of the mixtures of acetone+nitric acid; acetone+ammonium acetate; acetone+ethylacetate+ammonium acetate; butanol+ammonium acetate; and butanol+ammonium acetate+acetic acid. The separation of silver from lead and mercury(I) by 250 ml. of butanol+ ammonium acetate (1M) proved successful as lead was selectively eluted with (150 ml.) of this eluent; mercury (I) with next (100 ml.) portion of same eluent, whereas silver remained strongly adsorbed in reduced state on the resin. It was quantitatively eluted later on with 200 ml. of 4M nitric acid.

15. Extraction and Simultaneous Spectrophotometric Determination of Cobalt (II) with 2-Thenoyltrifluoroacetone.

S. K. MAJUMDAR and A. K. DE, Calcutta.

A method for the rapid extraction and the simultaneous spectrophotometric determination of cobalt (II) at milligram levels has been developed by utilising

2-thenoyltrifluoroacetone (TTA) in acetone. The bright yellow cobalt (II)-TTA chelate in acetone (benzene) adheres to Beer's law at 450 mμ over the concentration range of 12—51 γ of cobalt (II) per ml. Around pH 5·1- 6·8, cobalt (II) is quantitatively extracted from the aqueous phase by 0·15M TTA-acetone. The colour of complex is stable up to 96 hours. The system can tolerate as much as (0·5—10 mg.) each of silver, lead (II), mercury (II), thorium (IV), zirconium (IV), zinc (II) and strontium (II). The method is reproducible to within ±1·5%.

16. New reagent for titanium.

S. D. PAUL and M. S. KRISHNAN, Bombay.

2, 4, 6-trihydroxy phenylbenzyl ketone has been found to give yellow colour with titanium. This reaction has been used for the detection of titanium by spot test. The test is very sensitive and up to 0·05γ of titanium can be detected. The reagent can also be used for the detection of titanium in steel. Interference and mechanism of the reaction are also discussed.

17. Separation of Uranium and Thorium with Octylpyrophosphoric acid (OPPA) in a Phosphate medium.

R. S. JANI, Bombay.

The solvent extraction of uranium from phosphate rocks using octylpyrophosphoric acid reported earlier has been extended for the separation of uranium (VI) and thorium. The method is effective, both in phosphate and sulphate medii and has an advantage over using TBP in these respects. With 10% solution of octylpyrophosphoric acid in kerosene the extraction values of 96% for uranium and 91 per cent for thorium were obtained.

18. A Rapid Turbidimetric Assay Method of Chloramphenicol.

R. B. MUKHERJEE, J. CHATTERJEE, B. K. BOSE and B. N. DUTTA, Calcutta.

The microbiological assay of chloramphenicol is usually carried out by the diffusion plate assay that is, cup plate method employing *Sarcina lutea* or *Bacillus subtilus* as test organisms; the former method has been adopted as the recommended method of the U.S.P. XVI 1960. Assay by the measurement of antimicrobial activity may be accomplished by turbidimetric, i.e., the 50% inhibition of *Shigella sonnei*, but due to pathogenic character of this organism the method has not been accepted as a routine procedure. Due to inherent advantages of the turbidimetric (tube) assay procedure as being more sensitive than the plate method and very rapid requiring only 3-4 hours instead of about 16-18 hours in case of cup plate technique, this method has been employed in the assay of chloramphenicol using different fast growing organisms such as *Micrococcus pyogenes var aureus 6538 P*, *Escherichia coli* mutant (3 strains), *Klebsiela pneumoniae ATCC 10031*, *Salmonella typhosa* (3 strains), *Salmonella paratyphosa B*, *Shigella paradysenterica*, *Shigella sonnei*. Chloramphenicol and other antibiotics can be assayed microbiologically employing *L. arabenosus 17-5* and *L. casei ATCC 7469* grown in enriched media employed for the vitamin assay instead of nutrient broth. Standard conditions of assay viz., dose of inoculum, time of incubation etc., were worked out with each of the microorganisms and reproducible results were obtained with errors permissible under biological assay. The concentration of the drug to produce 50% inhibition of the maximum growth and the minimum effective dose of the drug were determined in case of all these organisms. It has been found that any of the strains can be employed for the microbiological determination of chloramphenicol. Of all the strains of assay organisms studied, *E. coli* (any standard strain), *Micrococcus pyogenes var aureus ATCC 6538 P* and *Lactobacillus arabinosus 17-5* may be recommended for the routine turbidimetric assay of chloramphenicol. This same technique has been found successful for the turbidimetric assay of penicillin and tetracycline. The assay values obtained by this procedure were found to agree fairly well with those obtained by the simultaneous determination of chloramphenicol by the cup plate method employing *Sarcina lutea* and the ultraviolet spectrophotometric method. The advantages of this turbidimetric method over the cup plate technique and the possible applications of the method in the assay of mixtures of antibiotics and rapid determination of bacterial sensitivity tests of recently evolved antibiotic resistant strains have been discussed.

19. Estimation of Polyvinylpyrrolidone in Plasma Substitute Preparations.

KANTI BASU and B. N. DUTTA, Calcutta.

Polyvinylpyrrolidone (PVP) developed during the last great war in Germany is being widely employed as a plasma substitute in the treatment of different conditions of shock, circulatory failure and fluid loss. Three different methods of assay have been developed by us and compared with the standard kjeldahl technique of estimation of nitrogen.

The ultraviolet spectra of the PVP solution at pH 1, 5 and 12 were studied using Hilger Uvispeck Spectrophotometer. PVP was found to exhibit peak at 212 mμ at pH 1 and 5 at 215 mμ at pH 12. The spectrophotometric method consists of diluting the PVP solution to the concentration of drug to about 70—80 mcg/ml, adjusting the pH to 5 (approx.) and reading the absorbance of the solution at 212 mμ. The turbidimetric method consists of adding trichloracetic acid to the PVP solution in presence of gum acacia solution and reading the turbidity produced at 660 mμ in a Klett Summerson photoelectric colorimeter. This method obeys the Beer's Law for concentration of PVP 200 to 1000 mcg per ml. of the final reaction mixture. PVP was found to produce a red colour by reacting with p-dimethylamino benzaldehyde in presence of sulphuric acid, which exhibits a typical spectra at 205 mμ, 235 mμ, 303 mμ and 351 mμ in the ultraviolet region and at 520 mμ in the visible region. This reaction has been developed into a colorimetric method of assay of PVP, which consists of reading a solution containing PVP about 30—40 mcg/ml. at 352 mμ or at 520 mμ. The kjeldahl method followed by us consists of digesting the sample containing about 350 mg. with concentrated sulphuric acid in presence of anhydrous sodium sulphate, and selenium and distilling off the ammonia in 4% boric acid solution and titrated with N/10 H_2SO_4 using methyl red as indicator. A comparative study shows that all these methods gave about the same average value of PVP in plasma substitute preparations. The spectrophotometric assay method appears to be the most accurate and should be the method of choice. The colorimetric method with dimethylaminobenzaldehyde is difficult to manipulate for reproducible results and cannot be recommended as a routine procedure. On the other hand, the turbidimetric method has been found to be rapid and accurate and can be adopted in a laboratory for the routine analysis of PVP. The kjeldahl method of estimation of nitrogen requires about a minimum of 4 to 5 hours but by using the spectrophotometric or turbidimetric method the analysis can be completed within a period of 15-20 minutes.

20. A Rapid Colorimetric Assay Method of Tetracycline, Oxytetracycline and Chlortetracycline.

K. C. AGRAWAL and B. N. DUTTA, Calcutta.

A new colour reaction of tetracycline, oxytetracycline and chlortetracycline has been investigated. It was found by us that the yellow colour given by tetracycline, and chlortetracycline on heating with hydrochloric acid is much intensified by the addition of alcoholic sodium nitrite solution and acetic acid. Under similar conditions of treatment oxytetracycline does not give any colour with hydrochloric acid but produces a yellow colour on treatment with alcoholic sodium nitrite solution and acetic acid. The colours formed by tetracycline, oxytetracycline and chlortetracycline were found to exhibit maximum peaks at 450 $m\mu$, 430 $m\mu$ and 480 $m\mu$ respectively and are found to be stable for 5—10 minutes. Different conditions for maximum colour development viz., time, temperature, concentration, hydrochloric acid, acetic acid and solvent were studied and the colour produced are read at their appropriate wavelengths in a spectrophotometer or Klett Summerson photoelectric colorimeter for the colorimetric determination of the tetracycline group of antibiotics. It was further observed that this colour reaction is not shared by any of the antibiotics—penicillin G (sodium or potassium), streptomycin or dihydrostreptomycin or chloramphenicol. Thus, this method can be employed for the determination of tetracycline or its derivatives in mixtures with the other antibiotics. This method is rapid and the analysis can be completed easily within 25 minutes. Moreover, this method has the special advantage over the U.S.P. control assay method where the taking of the readings exactly after six minutes after addition of alkali is difficult from practical standpoint of view.

21. Estimation of Strychnine in Pharmaceutical Preparations.

KANTI BASU and B. N. DUTTA, Calcutta.

The method of estimation of strychnine in pharmaceutical mixtures containing quinine, emetine, or atropine, iron and manganese salts and glycerophosphates is very difficult, laborious and time-consuming and the literature on the subject is relatively sparse. New colour reactions of strychnine have been studied for its quantitative determination. The first method is based on the formation of a yellow nitro compound with strychnine by treatment with nitric acid (1 : 1) and phosphoric acid which becomes intensified to a golden yellow colour by treatment with sodium hydroxide solution. The spectra of the compounds of strychnine formed in both acid and alkaline solution were studitd in a Hilger Uvispeck Spectrophotometer. In nitric acid solution the yellow colour exhibits absorption peaks at 235 $m\mu$, 303 $m\mu$ and 365 $m\mu$ while the golden colour in the alkaline solution exhibits peaks at 231 $m\mu$, 304 $m\mu$, 375 $m\mu$ and 425 $m\mu$. The assay procedure consists of measuring the golden yellow colour at 425 $m\mu$ in a suitable spectrophotometer or Klett Summerson photoelectric colorimeter using Filter 42. Different procedures for estimation of strychnine in pharmaceutical formulations in presence of quinine and iron and other metallic salts have been worked out. This method is not applicable to the estimation of strychnine in presence of atropine or emetine. The second method is relatively more sensitive and is based on the development of an intense red colour with ceric ammonium sulphate in presence of sulphuric acid and acetic acid. The spectra of the red colour in the visible range shows maximum peak at 505 $m\mu$ and the assay procedure consists of measuring absorbance of the coloured solution at 505 $m\mu$ within 10 minutes of its development. This reaction is not shared by quinine, atropine or emetine and therefore, can be employed for the determination of strychnine in their presence in different pharmaceutical mixtures. Recovery experiments show that both the methods are rapid, quantitative and can be recommended for the determination of strychnine in different types of pharmaceutical mixtures.

22. A new method for Direct Spectrophotometric Determination of Aluminium with SPADNS.

GURUPADA BANERJEE and A. N. CHOWDHURY, Calcutta.

A new spectrophotometric method has been developed for the direct determination of microgram amounts of aluminium using SPADNS as the colour-forming reagent. It is based on the fact that aluminium forms a blue-violet lake with SPADNS.

The procedure developed for the micro-determination of aluminium in the range from 1·0 to 15γ in 25 ml. of final volume involves the adjustment of pH (4-5), addition of 2 ml. 0·1% organic reagent and 2 ml. 1% freshly prepared starch solution as stabilizer, dilution to volume and measurement of optical density after definite interval of time in a Unicam SP600 spectrophotometer versus a reference solution of the reagent. Spectral transmittancy curve for the reagent blank and 100γ Al has been prepared and the optimum wavelength has been chosen as 590 mμ where the absorption of the reagent is very small. It has been observed that 2 ml. of a solution of 0·1% SPADNS is sufficient to complex at least 0·1 mg. of aluminium. Between a pH of 4·0 and 5·0, the absorption of Al-SPADNS lake remains constant and above pH 5·0, the absorption decreases rapidly. The coloured system obeys Beer's law in the range 1—15γ Al. The spectrophotometric sensitivity of the Al-SPADNS colour system is 0·05 γ Al per Cm^2. The empirical formula of the coloured complex has been determined by the slope Ratio method which suggests a 1 : 1 complex for aluminium with the reagent.

The method finds application in the direct determination of alumina in iron ore.

23. A rapid method for the determination of Sulphur in Coal.

M. M. ROY and A. N. CHOWDHURY, Calcutta.

A rapid method for the determination of total Sulphur in Coal and Coke, using vanadium pentoxide and platinised asbestos as the catalyst, has been developed. The whole experiment is completed within 20 to 25 minutes. In this method, the samples are mixed thoroughly with varying percentages of the catalysts and heated in a furnace at a temperoture of 800°—850°C in presence of oxygen and the issuing gases absorbed in Hydrogen peroxide. The resulting sulphuric acid was estimated by (1) Barium Sulphate precipitation method and (2) Direct Titration. The results show that the optimum concentration of platinised asbestos used should be 3% on the weight of sample taken, the maximum deviation being 0·04—0·45% in the case of low-sulphur coal or cokes, and 0·5 to 0·6% in case of high sulphur ones, as compared to the classical Eschka method. With 100% vanadium pentoxide as added substance, the results agree within less than 0·5%. Further works on the effects of mixture of varying percentages of platinised asbestos and vanadium pentoxide as also the effects of other catalysts are in progress.

24. Rapid Colorimetric Determination of Fluorides in Presence of Aluminium.

T. S. BHAKUNI and N. N. SHARMA, Nagpur.

Aluminium has been known to interfere with the estimation of fluorides in waters. Megregian (1954) used Zirconium Erio-chrome Cyanine-R lake for the estimation of fluorides. The effect of aluminium by this method was reduced to minimum provided two hours reaction time was allowed. Megregian attributes this behaviour to the formation of an unstable complex anion $(AlF_6)^{---}$ between aluminium and fluoride ions; fluoride ions are slowly released when the Zr-Erio-Chrome cyanine-R lake is added to the reaction mixture.

It has been observed that the complex ion $(AlF_6)^{---}$ is not formed at slightly elevated temperatures (35°C) and hence the colour of the lake gets bleached rather instantaneously enabling estimation of fluoride even in presence of aluminium. Based on this, a method for the estimation of fluoride in presence of aluminium is described using Bausch & Lomb spectronic-20 Colorimeter.

25. Colorimetric Determination of Divalent Copper with 2-Mercapto-3-phenyl quinazol-4-one.

G. C. AMIN (Shahad), Kalyan.

A solution of 2-mercapto-3-phenyl quinazol-4-one in sodium hydroxide has been found to give yellow coloration or precipitate with divalent copper solution; this could be completely extracted with chloroform giving yellow solution which has been employed for the colorimetric determination of copper.

26. Simultaneous estimation of Cobalt and Nickel with 8-Hydroxy-quinoline.

S. K. K. JATKAR, N. V. DESHPANDE and A. J. MUKHEDKAR, Poona.

Co+++ and Ni++ form complexes with excess of 8-hydroxyquinoline in the ratio Metal : ligand : : 1 : 2. Co+++—8-hydroxyquinoline complex absorbs at 365 mμ and 700 mμ; while Ni++—8-hydroxyquinoline complex absorbs only at 365 mμ in HCl-acetone medium. Beer's law holds good in the concentration range 1 to 25 mg. of the metal per liter. This method is therefore used for the simultaneous estimation of Co+++ and Ni++.

27. Determination of Ferrous Iron in Uranium bearing Minerals.

P. MURUGAIYAN, Bombay.

Presence of uranium (IV) is a serious interference in the determination of ferrous iron in minerals and ores. It has been shown that this interference could be removed by dissolution of the sample in phosphoric acid medium, in the presence of which, ferric iron is not reduced by uranium (IV). The ferrous iron can then be determined by titration with methylene blue as an indicator. Results obtained with various synthetic mixtures containing iron (II), iron (III) and uranium (IV) have been presented. If uranium (VI) is present in a mineral, it will alter the ferrous iron content during the dissolution itself.

28. Application of the use of Auxiliary Complexing Agent in the Spectrophotometric study of the systems of Titanium with Sulphosalicylic Acid and Ethylenediaminetetraacetic Acid by Job's Method in Equimolar Solutions.

R. M. SATHE and CH. VENKATESWARLU, Bombay.

The composition of the complexes formed between titanium and sulphosalicylic acid in 5% H_2SO_4 and at pHs 3·1 and 5·0 have been determined by the

Job's method in equimolar solutions. In the latter case, correct composition could only be obtained by using an auxiliary complexing agent to eliminate the troublesome side reactions of hydrolysis and polymerisation of the metal ion. The composition of the colourless Ti-EDTA complex has also been established by using sulphosalicylic acid as an auxiliary complexing agent. The stability constants for Ti-SSA system are derived from the known value of the Ti-EDTA system. From this, the stability constants for the Ti-oxalate and Ti-malonate systems are calculated.

29. Polarographic study of Indium Thiocyanate Complexes.

T. P. RADHAKRISHNAN and A. K. SUNDARAM, Bombay.

The polarography of indium in ammonium thiocyanate medium is studied. The variation of the half-wave potential of indium as a function of ammonium thiocyanate concentration has been studied at an ionic strength of 2·0 in perchloric acid-sodium perchlorate medium. The results are interpreted on the basis of complex formation of indium with thiocyanate. The estimated values of the overall constants for the complex ions $In(SCN)^{++}$, $In(SCN)_2^{+}$, $In(SCN)_3$, $In(SCN)_4^{-}$, $In(SCN)_5^{--}$, and $In(SCN)_6^{---}$ are $1{\cdot}2\times10^2$, $1{\cdot}6\times10^3$, $1{\cdot}75\times10^4$, $1{\cdot}7\times10^4$, $6{\cdot}5\times10^4$ and $6{\cdot}9\times10^4$ respectively.

30. Chromatographic Separation of Metallic Ions of the same group using Ethanol as solvent.

SHIB DAS BISWAS and ARUN K. DEY, Allahabad.

Attempts to identify and separate Ag (I), Hg (I), Pb (II), Hg (II), Bi (III), Cu (II), Co (II), Cd (II) As (III) Sb (III) Sb (V) Al (III), Cr (III), Fe (III), Zn (II), Mn (II), Ni (II), Cr (II), Ba (II), Sr (II), Co (II), in binary, ternary and quarternary mixtures of the same group of qualitative analysis by ascending filter paper strip chromotography has been made. Various concentrations of aqueous ethanol were tried and it was found that 50-60% ethanol gives good separations except in a few cases. The sequence of separation in mixtures has also been studied in detail.

31. Separation and Micro-identification of Anions using Weisz Ring Oven.

KAILASH NATH MUNSHI and ARUN K. DEY, Allahabad.

In 1954, Weisz devised the Ring Oven Technique for analysis of a number of cations in a single drop of a solution on a circle of filter paper. The chromatographic methods so far described for the separation and analysis of mixtures of anions require a lot of time. The present work describes a more rapid and new technique in which anions are separated chromatographically using the Weisz ring oven. Mixtures of micro-amounts of two, three or four of these anions can effectively be separated into distinct circular zones within 5 minutes. 60% ethanol, acetone and in some cases mixtures of both in a ratio 1 : 1 were used as solvents.

32. Colorimetric Determination of Iron (III) with 2-Napthol 3:6-di Sulphonate.

SURENDRA NATH SINHA and ARUN K. DEY, Allahabad.

A method for the colorimetric determination of iron (III) with 2-napthol 3 : 6 disulphonate (R-Salt) has been described. The composition of the chelate as determined by various methods using absorbance measurements is 1 : 2 (M Re$_2$) and the wavelength of maximum absorption is 580 mμ. The colour reaction is almost instantaneous. The coloured complex conforms to Beer's Law over an iron concentration of 0·37 to 20·16 p.p.m. The optimum pH range for the determinations is between 2·3 and 2·8 and temperature has no significant effect on the colour intensity. The sensitivity based on an absorption of 0·010 unit is 1·60 γ/cm.^{2} (Sandell) and 16·00 γ/cm^2. (Practical). Interferences by a large number of added foreign ions have been investigated in detail. Most of the common ions are found to interfere and should, hence, be removed before the determinations are made.

33. Murexide (Ammonium purpurate) as an indicator in thorium-ethylene-diamine tetraacetic acid titrations.

SATENDRA PRASAD SANGAL and ARUN K. DEY, Allahabad.

The use of ammonium purpurate as an indicator for the complexometric determination of thorium with EDTA has been described. Titrations are possible upto a concentration 0·005M of thorium at all temperatures and at pH 2·5. Many of the anions and cations are observed to interfere in the titrations except silver(I), mercury(II), aluminium(III), arsenic(III), manganese(II), alkali metals and the alkaline earths. Estimation of thorium in presence of iron(III) is possible by masking the latter with ascorbic acid.

34. A Rapid Paper Chromatographic Separation of micro-amounts of metallic ions using Weisz Ring Oven Technique.

ERIC JOHN SINGH and Arun K. Dey, Allahabad.

A simple and rapid micro-analytical method for the separation of metallic ions of the same group of qualitative analysis has been described. To solutions of two to five metal ions, some ethylene diamine tetraacetic acid is added, a drop is spotted on a filter paper circle and separations are affected on the ring oven using water-ethanol as solvent. The separation and identification of a mixture can be accomplished within five minutes. The presence of the complexing agent is necessary, in general, to secure good separations. The sequence of the separations and the effect of the concentration of the complexing agent are considered.

35. Quantitative estimation of certain metals with 3, 5-Dibromo Anthranilic Acid.

K. S. BHATKI and M. B. KABADI, Bombay.

A substituted product of anthranilic acid-3,5-dibromo anthranilic acid has been studied from the point of view of its use in inorganic analysis. The sodium salt of the reagent is used for estimating copper, nickel, zinc and silver. The precipitate obtained in each case is weighed directly as the organo-metallic complex. The silver complex obtained with the reagent does not appear to be susceptible to the action of ordinary light and hence the estimation of silver can be accomplished without taking any special precautions as to the effect of light.

36. A Highly selective method for Copper using Bis-Salicylaldehyde-ethylenediamine as Analytical Reagent.

B. R. SINGH and SATYA KUMAR, Nainital.

Copper precipitates quantitatively in the pH range of 8—13·5 as its Bis-Salicylaldehyde-ethylenediamine complex of formula $C_{16}H_{14}O_2N_2.Cu$ dried at 100—120°C. The complex is stable in presence of excess ammonia, 0·1 N alkali, ammonium salts and complexing agents as tartrate, citrate, sodium-thio-sulphate, fluoride, thiourea, triethanolamine and EDTA. In presence of tartrate and ammonia the ions of alkali metals, alkaline earths, $Ag+^1$, $Tl+^1$, $Tl+^3$, $Pb+^2$, $Cd+^2$, $Co+^2$, $Mn+^2$, $Pd+^2$, $Al+^3$, $Cr+^3$, $La+^3$, $Ce+^3$, $Au+^3$, $Pt+^4$, $Ti+^4$, $Zr+^4$, $Th+^4$, UO_2+^2, and anions as VO_3-^1, MoO_4-^2, WO_4-^2, CrO_4-^2, PO_4-^3, AsO_4-^3 do not interfere. $Ni+^2$ and $Hg+^2$ are masked by tartrate, EDTA and ammonia; $As+^3$, $Sb+^3$, and $Sn+^2$ are separated using fluoride as the complexing agent; at an alkalinity of 0·1 N caustic alkali in presence of tartrate $As+^3$, $Sb+^3$, $Sn+^2$, $Bi+^3$, $Zn+^2$ and $Fe+^3$ are separated. $Fe+^3$ can also be separated using triethanolamine as the masking agent at a pH of about 13·0. In this manner copper can be separated from almost all the ions, thus affording a highly selective method for the determination of copper.

37. Two Dimensional Paper Chromatographic Separation of Food Colours.

P. N. SEN GUPTA and S. N. MITRA, Calcutta.

To obviate the difficulty of separation and identification of a mixture of food colours, a two-dimensional paper chromatographic technique, using 20 cm^2 Whatman No. 1 paper, has been found to be useful. To find out two suitable solvent mixtures for this purpose, Rf values of 20 food colours of which 13 are "permissible dyes" under the P.F.A. Act, 1954, have been determined using 8 solvent mixtures and employing ascending technique. The paper is rolled and tied in the form of a cylinder and the chromatogram is developed from a petridish containing solvent and covered with a bell jar. Total solvent front is 18 c.m. The developed chromatogram of each colour has been treated with a drop of Conc. HCl and 10% NaOH and also exposed to ultraviolet ray to determine the changes in the chromatograms.

For two-dimensional chromatography, N. Butyl alcohol/3N. Acetic acid/Alcohol (5 :5 :2) as solvent I and 2% Trisodium citrate soln. in 5% (W/v) Ammonia as solvent II have been found to be most suitable. A drop of solution of a mixture of 13 'permissible' dyes is taken at one corner end and chromatogram is developed upward with solvent I. The paper is dried and again rolled and tied in opposite direction and put in solvent II. With the rise of this solvent, the strip of first chromatogram is further resolved and each of the 13 colours takes definite positions on the paper and these are noted for identification and also the Rf of each colour with respect to two solvents have been determined.

38. Thorin (1-0-Arsonophenylazo 2-Naphthol 3:6 Disulfonic Acid) as a Reagent for the Determination of Calcium in Nuclear pure Uranium.

C. S. PADMANABHA IYER and G. M. VAIDYA, Bombay.

The calcium-thorin system is studied for the first time. The optimum condition for the complexation occurs at pH 8—8·8, the complex showing maximum absorbance at 530 mμ. The specific extinction coefficient of the complex is found to increase, depending on the concentration of acetone added to the system. The formula of the complex is found to be 1 : 1.

Calcium in nuclear pure uranium metal is determined by using this reagent after a preliminary tributyl phosphate extraction to remove the uranium.

39. The Standardisation of Uvispek Spectrophotometer in the Region 220 mμ—500 mμ.

B. N. SRINIVASAN, Bombay.

The performance, that is the accuracy and reproducibility of the Uvispek spectrophotometer, was determined employing a standard alkaline solution of potassium chromate. The standard deviation values obtained, are compared with the collective data obtained on several Cary and Beckmann instruments in the region 220—500 mμ. The spectrum of alkaline potassium chromate shows a new absorption peak at 210 mμ having log $e_{10}=4{\cdot}10$.

40. A study of some carriers and internal standards for the Spectrographic determinations of the impurities in Thoria by the carrier distillation technique.

K. SRIKAMESWARAN, Bombay.

In order to select a suitable carrier for the estimation of some impurities in thoria by the carrier distillation technique, comparative study of a few carriers has been made. On the basis of this comparison, silver chloride, 5% by weight, has been found to be the most suitable carrier. By the moving plate technique, the volatilization characteristics of the impurity elements have been compared. The spectral lines of cobalt 2424·9A° and gallium 2500·7A° have been found to be satisfactory internal standard lines for the spectrographic estimation of the impurities.

41. Spectrographic determination of traces of Tantalum and Titanium in Niobium Oxide and of Titanium and Niobium in Tantalum Oxide.

L. C. CHANDOLA and U. R. N. SWAMY, Bombay.

A spectrographic method is described for the estimation of tantalum oxide and titanium oxide in the ranges 0·01—2% and 0·05—2% respectively on a niobium oxide base and also for the estimation of niobium oxide and titanium oxide in the ranges 0·025—1% and 0·025—2% respectively on a tantalum oxide base. Intermittent A.C. arc excitation has been utilised with a Hilger E 492 large quartz spectrograph. In niobium oxide matrix Nb 3081·77A° and Nb 2683·22A° are used as the internal standard lines for Ti 3078·64A° and Ta 2685·11A° analysis lines respectively. In the tantalum oxide matrix the lines Ta 2943·77A° and Ta 3182·57A° are used as the internal standard lines for Nb 2950·88A° and Ti 3186·45A° analysis lines respectively.

42. Spectrographic analysis of rare earths in Uranium and Thorium.

T. R. SARANATHAN and K. KAMALA, Bombay.

A spectrographic method for the estimation of Pr, Nd, Tb, Ho, Tm and Yb present in ppm levels in pure uranium and thorium is described. A d.c. arc excitation between graphite electrodes is used with a large quartz littrow mount spectrograph. Ti (3370·4A°) is used as the internal standard for Tb, Ho, Tm and Yb in the concentration range 0·1—2 ppm and La (4315·90A°) for Nd and Pr in the concentration range 0·2—4 ppm on 50 gms sample. The spectral lines used with the detection limits are given below :

Nd 4303·570, Pr 4225·327 ... ... 0·2 ppm
Tb 3323·40, Tm 3362·61, Ho 3398·98, Yb 3464·37 ... ... 0·1 ppm

43. ThB-ThC : A new Genetically related pair of Radionuclides for the growth-decay study.

P. P. PAREKH and M. SANKAR DAS, Bombay.

A new pair of genetically related radionuclides viz., $\underset{(Pb—212)}{\text{ThB}}$ —$\underset{(Bi—212)}{\text{ThC}}$ has been recommended for the study of

(1) The growth of a radioactive daughter from its initially pure parent species, and

(2) The rate of decay of the pure radioactive daughter.

Some of the salient features of the suggested system are the easy-availability of the source from which the above mentioned pair of radionuclides can be obtained; the short duration of the experiment (about 15 hours) in which time one can study

(1) the growth of the daughter product,
(2) the time of maximum activity of the mixture as well as daughter,
(3) the rate of decay of the mixture of radionuclides after attaining radioactive equilibrium, and
(4) the measurement of half-life of a simple radioactive decay of the pure daughter element.

The advantages of this pair over the systems in general use have been discussed.

44. Job's Method of continuous variation in non-equimolar solutions—effect of an Auxiliary Complexing Agent.

R. M. SATHE and CH. VENKATESWARLU, Bombay.

The complex formation between titanium and protocatechuic acid has been reinvestigated by using the Job's method of continuous variations in non-equimolar solutions in the presence of oxalic acid as an auxiliary complexing agent. The relative reliabilities of the method in the presence and absence of the auxiliary complexing agent are discussed by comparing data obtained on the same system.

45. A Simplified and Rapid Procedure for Determination of Uranium in Low Grade Ores.

A. J. PATKAR and B. L. RAO, Bombay.

A rapid method for the determination of uranium in low grade ores is described and is based on opening of the ore with potassium acid fluoride and taking the melt in saturated aluminium nitrate acidified with nitric acid. Fluoride and phosphate are complexed by aluminium nitrate. Separation of uranium is based on Burstall and Wells' cellulose chromatographic method and the final estimation is done by extraction of the DBM-uranium complex in carbon tetrachloride after complexing the residual elements with EDTA. Excellent results are obtained in U_3O_8 concentration as low as 0·001% in a variety of simple and complex minerals and ores.

46. Determination of Oxygen in Uranium Oxides.

K. A. KHASGIWALE, K. N. SIRIAH and M. SUNDARESAN, Bombay.

The low pressure method of estimating oxygen in uranium oxides higher than stoichiometric composition $UO_{2 \cdot 000}$ has been modified especially in respect of purification of hydrogen and new design of reduction cell to give an accuracy of ±1·5% on the excess oxygen in case of lower uranium oxides.

47. Chromatographic Analysis of Dyes in Pharmaceutical Preparations.

H. L. BAMI, Calcutta.

Several synthetic dyes are used both as colouring agents and bactericidals in various drug and pharmaceutical preparations. Amongst these, methylene blue (medicinal), acriflavin, proflavin, brilliant green and gentian violet have been commonly employed in eye lotions and other local antiseptic preparations. Based on partition chromatography on cellulose column using 30 : 70 benzene butanol mixture saturated with I N acetic acid as eluent, methylene blue and acriflavin components of several commercial eye lotions have been separated. Subsequently, the eluted dyes were colorimetrically analysed employing standard curves prepared for each dye similarly. Minimum accuracy of the technique developed, was ±10% as verified by duplicate analysis of known dye mixtures. Analysis of commercial samples of eye lotions has also revealed that the concentration of dyes was sometimes not properly adjusted during manufacture. The present analytical technique is being extended to other pharmaceutical preparations containing one or more of these dyes.

INORGANIC

48. Hydrazine Fluoride complex of Uranium (IV) and its Thermal Decomposition.

BALARAM SAHOO, B. TRIPATHY and D. PATNAIK, Cuttack.

Solar energy has been used for the photochemical preparation of hydrazine uranium (iv) fluoride complex when a solution of uranylnitrate in hydrofluoric acid, hydrazine and alcohol is exposed to sunlight, a bright green crystalline compound of hydrazine uranium (iv) fluoride $N_2H_5FUF_4$ is obtained in the anhydrous state. The thermal decomposition of the compound in vacuum at about 400°C readily gives anhydrous uranium tetrafluoride. Of the various methods in use for the preparation of uranium tetrafluoride the method incorporated, appears to be simple, convenient and eliminates many of the mechanical operations.

49. Differential behaviour of Ammonium Uranium (IV) Fluoride complex towards Hydration.

BALARAM SAHOO and D. PATNAIK, Cuttack.

Anhydrous and hydrated ammonium uranium (IV) fluoride complex have been prepared by following different methods for reduction. The difference in behaviour of the anhydrous complex towards water has been attributed to different structural forms. It is suggested that in energetic and vigorous reduction processes, such as electrolytic and nascent hyposulphurous acid lattice type anhydrous compound of NH_4F, UF_4 is formed while with less energetic reduction processes such as photolysis and copper catalysed sulphur dioxide reduction hydrated co-ordination compound NH_4F, UF_4, H_2O is obtained.

50. Preparation of Uranium (IV) Succinates and Uranium (IV) Tartarate.

K. C. SATAPATHY, BALARAM SAHOO and D. PATNAIK, Cuttack.

Uranium (IV) succinate having the formula $UO(C_4H_4O_4)$, $3H_2O$ has been isolated by the photochemical reduction of uranyl formate and succinic acid in presence of alcohol. Sun light has been used as the source of energy. A different compoud having the composition $UO(C_4H_4O_4)$, $U(C_4H_4O_4)_2$ has been prepared by the action of succinic acid on uranium (IV) oxycarbonate.

A tartarate compound of uranium (IV) having the composition $UO(C_4H_4O_6)$, $U(C_4H_4O_6)_3$, $5H_2O$ has been prepared by photochemical method.

51. A Note on the Preparation of Uranium Dioxide.

C. R. DAS, B. SAHOO and D. PATNAIK, Cuttack.

The thermal decomposition of Uranium (IV) oxyacetate ond Uranium (IV) oxyformate has been studied in vacuum and in an atmosphere of ammonia at about 450°c. It has been found that with oxyacetate the product of decomposition in vacuum contains fifty per cent uranium dioxide, which is enhanced to ninety percent when decomposition is carried out in presence of ammonia. However with oxyformate, ninety per cent yield of uranium dioxide in vacuum is raised to ninety-five percent when heating is conducted in atmosphere of ammonia at 450°C.

52. On 4-Nitrophthalates of Thorium and Uranium (VI) and their separation.

G. S. RAO, N. S. K. PRASAD and A. J. SINGH, Bombay.

Thorium and uranium (IV) have been found to form insoluble compounds with 4-nitrophthalic acid under different conditions of precipitation. The compounds have been prepared in crystalline state and their chemical analysis shows that uranium forms uranyl diammonium dinitrophthalate $UO_2[C_6H_3(COO)_2NH_4NO_2]_2$ while thorium forms dinitrophthalate $Th[C_6H_3(COO)_2NO_2]_2$. Advantage has been taken of the fact that these precipitates are formed under different conditions of acidity, concentrations of the reagent and metal ion, in separating the two elements. This paper deals with the nature of compounds formed by uranium (VI) and thorium with 4-nitrophthalic acid and the conditions of their separation using this reagent.

53. Complex compounds of Copper with Mono-, and Di-, N-Phenyl Thioureas.

S. N. BANERJEE, Kharagpur, and A. C. SUKTHANKAR, Bombay.

Several complex compounds of mono-, and di-, N-phenyl thioureas with copper salts *viz.* (i) CuOH. Ph.Th. 0·5 H_2O, (ii) CuOH.2PhTh. H_2O, (iii) 2CuCl. 5PhTh, (iv) Cu_2SO_4.6PhTh, (v) $CuNO_3$. 4PhTh.HNO_3.$3CH_3COCH_3$, (vi) CuOH.PhThPh,

(vii) Cu_2SO_4.2PhThPh, (viii) CuCl.2PhThPh have been prepared and their properties studied. Of these complexes, three (Nos. (ii), (iii) and (iv)) have already been reported, and the rest are described probably for the first time. ('Th' represents NH_2CSNH_2; 'PhTh', $C_6H_5NHCSNH_2$ and 'PhThPh', $C_6H_5NHCSNHC_6H_5$ molecules).

From a critical study of the copper-thiourea complexes in general, it has been shown that the tendency for coordination of thiourea with cuprous ion, decreases with an increase of the number of substituents in the parent thiourea ligand *viz.*

"Thiourea>Mono-Phenyl Thiourea>Mono-Acetyl Thiourea>Di-phenyl thiourea".

Further investigations on this line with other substituted thioureas are under progress.

54. Complex compounds of Copper with mono-N-acetyl-, and of Silver with mono-, and di-, N-phenyl Thioureas.

S. N. BANERJEE, Kharagpur and A. C. SUKTHANKAR, Bombay.

The following compounds *viz.* (1) CuCl. 2AcTh, (2) Cu_2SO_4. 4AcTh, (3) 2CuNO_3. 5AcTh.2HNO_3, (4) CuOH.3AcTh, (5) 2$AgNO_3$. 5AcTh, (6) $AgNO_3$. PhTh, and (7) $AgNO_3$. PhThPh have been prepared and their properties studied. Of these complexes nos. (2) and (6) have already been reported, and the rest are presented probably for the first time. ('Th' represents NH_2CSNH_2; 'PhTh', $C_6H_5NHCSNH_2$; 'PhThPh', $C_6H_5NHCSNHC_6H_5$ and 'AcTh', $CH_3CONHCSNH_2$ molecules).

Attempts are being made to prepare similar compounds with other metal salts under various experimental conditions, and to investigate their stability constants, in order to solve the problem of constitution of metal—thiourea complexes of various types.

55. Metal Complexes of 1-phenyl-3-α-pyridyl triazene.

A. K. MAJUMDAR and S. C. SAHA, Calcutta.

Stable complexes of 1-phenyl-3-α-pyridyl triazene (PPTh) with Cu (I), Cu (II), Ni (II), Co (II) and Pd (II) were isolated. These complexes are either insoluble or has very little solubility in organic solvents. Ni (II), Co (II) and Cu (II) form compounds of empirical formula $M(PPT)_2$. An octahedral structure for the Ni (II) complex was suggested based on its dimeric nature, magnetic moment and high stability. 1-phenyl-3-α-pyridyl triazene functions as a tridentate ligand and acts as a bridge between two nickel ions. Magnetic moments of the Cu (II) and Co (II) complexes suggest the same type of structure as that of Ni (II). But the point could not be clearly proved because of the inability to determine their molecular weights.

The quadricovalent Pd (II) complexes, Pd(PPT).X, and the cuprous complex, Cu(PPT).Py, are diamagnetic. A polymeric bridged structure, as suggested for palladium (II) chloride, and a linear structure have been proposed for the respective complexes. The cuprous complex being unstable changes to green cupric compound on standing in pyridine solution. Attempts to prepare Co (III) complex starting from hexamine Co (III) chloride always led to the formation of a Co (II) compound.

For the elucidation of the structure of the above complexes, spectral studies, visible and infrared, are underway.

56. Ion-Exchange study of thiocyanate complexes. Part I—Cation-Exchange resin.

A. K. MAJUMDAR and B. K. MITRA, Calcutta.

Cation-exchange behaviour of the thiocyanate complexes of Hg (II), Cu (II), Cd (II), Zn (II), Pb (II) and Bi (III) have been studied. Stability of the complexes being different under certain thiocyanate concentrations, effective separations of the said elements from each other have been achieved. The metal ions after been adsorbed on the Amberlite—IR-120 (NH_4^+ form) resin are eluted with thiocyanate of varied concentration. Thus, while Hg (II) is completely eluted with a 0·5 percent solution of ammonium thiocyanate, Cu (II), Cd (II) and Zn (II) require, respectively, 2, 3 and 4 percent of the said solutions for their complete elution. For Bi (III), a 6·0 per cent solution of the thiocyanate, acidified with nitric acid to 0·1 (N), is highly satisfactory. Pb (II) is unaffected and remains on the resin bed, from which it can, however, be eluted with 6·0 percent ammonium acetate solution.

57. Studies on Transitional Metal Complexes. Part I—Quadricoordinate Ni^{II} complexes.

A. K. MAJUMDAR and B. C. BHATTACHARYYA, Calcutta.

Co-ordination complexes of Nickel (II) with a tridentate schiff's base, obtained by coupling salicylaldehyde with anthranilic acid, have been studied. The composition of the complexes is $Ni(C_{14}H_9O_3N)X$ where $X=NH_3$, $C_2H_5NH_2$, $(C_2H_5)_2NH$, C_5H_5N, $2H_2O$, $1/2\,[NH_2(CH_2)_2NH_2]$ and α-, β- and γ-picolines. The study of the magnetic moment of these complexes distinguishes two types of structures. $Ni(C_{14}H_9O_3N)NH_3$ and $[Ni(C_{14}H_9O_3N)]_2(en)$ are square planar being diamagnetic and are not susceptible to oxidation. The compounds $Ni(C_{14}H_9O_3N)X$, when $X=2H_2O$, C_5H_5N and α-, β- and γ-picolines, are paramagnetic with moments corresponding to the presence of two unpaired electrons. This indicates either a tetrahedral or a distorted octahedral configuration. The reason for the low moment of $Ni(C_{14}H_9O_3N)\text{-}C_2H_5NH_2$ (1·0) and $Ni(C_{14}H_9O_3N)\,(C_2H_5)_2NH$ (1·75) is not yet known. The investigation is in progress to elucidate the structures fully.

58. Separation of niobium and tantalum from each other with Benzohydroxamic acid and Phenyl-acetyl-hydroxamic acid.

A. K. MAJUMDAR and BIJOLI K. PAL, Calcutta.

Benzohydroxamic acid and phenyl-acetylhydroxamic acid have been utilised separately for affecting the separation of tantalum from niobium. These reagents, though fail to precipitate either niobium or tantalum from tartrate and citrate solutions, give quantitative precipitation of tantalum from oxalate medium. Niobium, however, remains in solution, from which it can be recovered by quinaldinohydroxamic acid or N-benzoyl-N-phenylhydroxylamine. Thus separated the tantalum precipitate needs ignition to oxide for the final weighing, the niobium precipitate can be weighed after drying at 110°C or after ignition to oxide.

Benzohydroxamic acid can be used at a pH between 4·0 and 6·4 for the complete separation of tantalum from niobium present in a ratio of 1 :18 to 20 :1 by a single precipitation, while phenylacetylhydroxamic acid premits under a pH of 4·5 to 6·2 a satisfactory separation of tantalum from niobium by single precipitation when they are present up to a maximum ratio of 1 :8. For other ratios dissolution and reprecipitation of tantalum are necessary.

Titanium, zirconium, tartrate and citrate seriously interfere.

59. Basic Carbonate of Aluminium.

MANIKLAL SEN GUPTA, Calcutta.

Precipitation of aluminium sulphate with sodium carbonate yields a product containing varying amounts of aluminium hydroxide, sodium bicarbonate and carbon dioxide. The carbon dioxide content is influenced by conditions of precipitation, such as excess of alkali used in precipitation, the concentration of the solutions and the temperature. The extent of coprecipitation of sodium bicarbonate increases with increasing excess alkali or temperature of precipitation and decreases with dilution; the carbon dioxide associated with the alumina on the other hand decreases with too much excess alkali, with dilution as well as with increased temperature. Under the best favourable conditions, the carbon dioxide content, allowing for that combined with residual alkali is about 16 g. per 100 g. Al_2O_3. This product is fairly stable at 40°C, and heating causes a rather stepwise elimination of carbon dioxide. The presence of carbon dioxide ensures ready solubility of the dried precipitate in dilute acids, the solubility decreasing as the carbon dioxide content is lowered.

60. Extraction of Germanium from Fly-ash.

G. S. RAO, K. M. ABUBACKER, T. KESAVA DAS and C. T. MEHTA, Bombay.

The importance of germanium in transistor technology and the desirability of developing it in this country instigated a search for the sources of germanium and the possibility of extracting the same from such sources which are available. The only source of germanium so far discovered is the fly-ash (or flue dust) in which it gets concentrated under suitable conditions when coal samples containing germanium are burnt. Such fly-ash samples were collected from various power houses and factories and analysed for their germanium content. The method of extracting germanium from the samples by direct chlorination was studied in detail and optimum conditions for maximum recovery from 500 gm. lots have been established. The percentage recovery on this scale was found to be between 75 and 85 percent.

61. Studies on Peroxy Titanium Malonate.

G. V. JERE and C. C. PATEL, Bangalore.

During our studies on peroxide chemistry of titanium, an orange red complex—peroxy titanium malonate—was prepared for the first time by reaction of freshly precipitated titanium hydroxide with excess of hydrogen peroxide and malonic acid. The complex is a true peroxy compound and not a perhydrate. The molar composition of the complex is, $Ti : Malonate : O_{peroxy} \cdot H_2O$ as 1 :1 :0·88 :3, suggesting the composition of the compound as $TiO_2(OOC.CH_2.COO).3H_2O$. Several physico-chemical studies have been carried out. The absorption maximum for the complex is at 378 mμ (log $\varepsilon = 2{\cdot}91$). Job's method of continuous variation gives $Ti : O_{peroxy}$ ratio as 1 :1, but the peroxy oxygen content in the solid complex is lower than the stoichiometric value because of the gradual loss of peroxy oxygen from the complex. Of the three water moles, two are coordinated to central titanium, while the third is loosely held and can be removed under vacuum. The complex is amorphous and diamagnetic. The differential thermal curve shows an exothermic peak at 100°C for the decomposition of the peroxy group from the complex. The infrared spectrum of the complex gives the bands at—3175(vs), 1667(vs), 1610(vs), 1443(s), 1370(s), 1290(w), 1167(w), 1041(m), 909(s), 891(w), 810(m) and 721 (m) cm−1. These bands have been characterized. The dissociation constants of the malonate group and of the peroxy group are, $2{\cdot}56 \times 10^{-3}$ and $2{\cdot}8 \times 10^{-5}$ respectively. From the above studies, the structure of the complex has been assigned.

62. Recovery of Silver in the laboratory by Hyposulphurous Acid.

N. C. NAIK, B. SAHOO and D. PATNAIK, Cuttack.

Extraction of silver from silver halides has been achieved by a convenient method. Nascent hyposulphurous acid has been used as the reducing agent. Silver is obtained quantitatively in the fine state which can be dissolved in moderately concentrated nitric acid and can be crystallised in the form of the silver-nitrate.

63. Preparation of ideal γ-MnO_2, for dry battery manufacture.

A. N. CHOWDHURY, B. DAS SARMA and G. P. BASU CHAUDHURY, Calcutta.

A method for the preparation of ideal γ-MnO_2 has been described. This variety of manganese dioxide is believed to be responsible for the long cell life, higher and consistent amperage and voltage of all dry batteries. The method consisted of slow reaction of concentrated potassium permanganate solution with concentrated nitric acid at 80—90°C with constant stirring. The material washed and dried in air was found to contain ideal γ-MnO_2 structure by X-ray investigation. This material mixed with nine times its weight of non- γ manganese ores from various Indian mines produced batteries of excellent quality as compared to batteries wtih imported, synthetic γ-MnO_2 used in battery industry. This work shows that all of the synthetic γ-MnO_2 imported by Indian dry-battery manufacturers can be locally prepared.

64. Studies on the composition and stability of Chelate formed between Zirconium and Sulpho-dichloro Hydroxy-dimethyl Fuchson Dicarboxylic Acid.

ROSHAN LAL SETH and ARUN K. DEY, Allahabad.

A detailed study has been made on the composition and stability of the chelate formed between zirconium and sulpho-dichloro hydroxy-dimethyl fuchson dicarboxylic acid (Chrome Azurol S) using absorbance and electrical conductance measurements. The composition of the chelate has been studied by (i) Job's method of continuous variations, (ii) the mole ratio method and (iii) the slope ratio method. The results have further been corroborated by electrical conductance measurements. The chelate has its maximum absorption at 530 mμ. The stoichiometry of the chelate has been found to be 1 :1. It is stable between pH 1·5 and 5·5. The value of the stability constant (log K) as determined by the continuous variations method and the mole ratio method using absorbance data is found to be $4{\cdot}9 \pm 0{\cdot}1$ and $5{\cdot}0 \pm 0{\cdot}2$ respectively at temperature 25°C and pH 2·5. The free energy change of formation calculated from the two values of log K comes out to be $-6{\cdot}72 \pm 0{\cdot}14$ and $-6{\cdot}85 \pm 0{\cdot}28$ K Cals. respectively.

65. Studies on complex formation between beryllium ions and morin in solution.

(KUM.) S. R. JAGASIA and B. C. HALDAR, Bombay.

The formation of a complex compound containing beryllium and morin in the ratio 1 : 1 has been shown by thermometric and conductometric titrations of morin with beryllium surfate. The composition of the complex has been confirmed by Job's Continuous Variation method.

66. Chelate formation of ferric ion with 2:naphthol-3:6-disulphonate—A spectrophotometric study.

SAMIR K. BANERJI, Pilani.

A spectrophotometric and conductometric investigation of the chelate formed between iron (III) and 2-naphthol-3 : 6-disulphonate (R-salt) has been made. The composition as determined by the method of continuous variation is found to be $Fe(RAS)_2$. The chelate has been found to be stable between a pH 2 and 4, and the investigations have been carried out in that pH range. The chelate is deep blue in colour and has a λ_{max} at 580 mμ. The stability has been calculated by a method described earlier and the value of logK is $8{\cdot}77 \pm 0{\cdot}14$ and the value of free energy of formation is $-12{\cdot}10 \pm 0{\cdot}20$ kcals at 25°C.

67. Kinetics of Reduction of Rhenium (V) by Tin (II) in Hydrochloric Acid Media.

M. S. MOHAN, Calcutta and D. BANERJEA, Durgapur.

The kinetics of reduction of rhenium (V) to rhenium (IV) by tin (II) has been studied spectrophotometrically in hydrochloric acid media (3—6 M.). The reaction has been found to be of the first order with respect to both rhenium (V) and hydrochloric acid and has an order of 0·5 with respect to tin (II); it is independent of tin (IV). A reaction mechanism has been suggested to explain the observed facts. It is necessary to assume that in hydrochloric acid media tin (II) exists chiefly as a binuclear chloro-complex and the reduction takes place through transfer of protons from (mononuclear) chlorostannous acid to the rhenium (V) in two steps. Activation energy of the process has been determined as usual, the value being 10·4 k. cal.

68. Association of Metallic Ion with Azide : Polarographic Study.

I. P. SINGH, Calcutta and D. BANERJEA, Durgapur.

The association of zinc, cadmium and thallous ions with azide has been studied polarographically by the method of DeFord and Hume (J. Am. Chem. Soc., 73, 5321, 1951) in aqueous solution at 25°C and at a constant ionic strength (μ, 2) in sodium perchlorate medium. The various species which appear to be present in the solutions and their overall formation constants are given below : ZnN_3^+, 4·8; $Zn(N_3)_2$, 10·3; CdN_3^+, 7·8; $Cd(N_3)_2$, 26 and TlN_3, 2·5. The results indicate that azide has a weak complexing ability.

69. A New Arrangement of the Periodic Table of the Chemical Elements—Part V.

V. S. PATEL, Betul, U.P.

In this paper certain explanations have been incorporated in view of the critical suggestions on the previous four parts of the new circular arrangement on the following lines :—

(1) A perfect increasing serial order has been maintained in this circular system.

(2) The breaking of the zero group and the VIII group is not necessary except for convenience.

(3) The electronic configuration of the elements is also kept in mind.

(4) The position of hydrogen in the centre of the table, and the gradation in the electropositive and electronegative nature of the elements, have been pointed out.

This is rather an effort to depict a more natural periodic arrangement of the atoms represented in the pattern of lines of force and equipotential surfaces.

70. Study of the Compound formed during the Oxidation of Mercurous Nitrate by Potassium Persulphate.

J. C. GUPTA and S. P. SRIVASTAVA, Naini Tal.

During the kinetic studies of the reaction between mercurous nitrate and potassium persulphate, it was observed that solid compounds are formed at high concentration of the reactants in suitable nitric acid concentration. With increasing concentration of nitric acid, the amount of the solid decreases so much so that at greater concentrations of the acid, no solid separates out. Ordinarily, there seem to be two types of precipitates, one which is yellow in colour, formed at lower concentrations of the acid, and the other which is white with slight tint of greyness, formed at higher concentrations of nitric acid. Both types of precipitates are affected by light and boiling water and both of them contain mercurous, mercuric and sulphate ions. It is also observed that the yellow precipitate is more easily soluble in nitric acid than the white-grey precipitate. Both type of precipitates do not contain any water of crystallisation.

Further work to establish the chemical composition of these precipitates is in progress.

71. Resolution of Rhodium (III) Trisbiguanidinium and Iridium (III) Trisbiguanidinium Complexes.

S. P. GHOSH ond A. I. P. SINHA, Patna.

Rhodium (III) trisbiguanidinium chloride and Iridium (III) trisbiguanidinium chloride have been resolved into their optical isomers by forming diastereoisomers with d-tartrate. In both cases the leavogyrate forms the less soluble variety. The molecular relations for Rhodium (III) trisbiguanidinium chloro-d-tartrate and Iridium (III) trisbiguanidinium chloro-d-tartrate of $[M]_D = 951°$ and $[M]_D = 893°$ respectively. The chloride, nitrate and sulphate of both laevo- and dextro- series of each metal-complex ion have been prepared and their rotations measured. The salts are extremely stable optically and do not show appreciable racemisation even on boiling with active charcoal for several hours.

72. Thermal Decomposition of Metal Biguanide Complexes.

S. P. GHOSH ond A. I. P. SINHA, Patna.

Thermal decomposition of Copper (II), Nickel (II), Palladium (II)-bisbiguanidinium chloride and Cobalt (III),- Rhodium (III)-, and Iridium (III)-trisbiguanidinium chloride has been studied thermogravimetrically. With a heating rate of 4°/minute the first three, hydrates, lose their water of crystallisation between 60-90°. The first decomposition of the complexes proper starts at 218°, 250°, 268°, 265°, 320° and 330° respectively. In case of copper, nickel and cobalt complexes a definite break in the weight-loss curve is observed at points corresponding to the loss of one molecule of ammonia per biguanide molecule attached to the central metal atom. In the cobalt series the decomposition temperature evidently increases with the electronegativity of the metal. This order is also followed in the case of nickel and palladium. The behaviour of the copper complex is rather anomalous in two respects : (i) though thermodynamically copper (II)- is more stable than the nickel (II)-biguanide-complex the order is reversed in respect of thermal stability, (ii) the detachment of the two ammonia molecules from the two biguanide molecules takes place distinctly in two steps, one molecule being evolved very rapidly at 218° and the other rather slowly up to 240°. The final residue at 600-700° is generally the oxide of the metal but in case of copper and palladium complexes the residual weight level indicates the presence of a little reduced metal as well.

73. Uni-Valent Manganese Complex.

D. V. RAMANA RAO, Cuttack.

Dimanganese decacarbonyl reacts with diarsine under optimum conditions to form a diamagnetic dimer, $[Mn(CO)_3 \text{ Diars}]_2$ and a paramagnetic monomer. When titrated spectrophotometrically with iodine in chloroform, both the substituted manganese carbonyls react without any loss of carbon monoxide (as measured by gas burette), a sharp end point occurring after one equivalent of iodine has been added. The compound, $Mn(CO)_3 \text{ (Diars)}_1$, was isolated in pure condition.

The product is a non-electrolyte and is diamagnetic. The compound in chloroform solution shows three peaks (C-O stretching vibration) in the infrad red spectrum at 2032 (w), 1957 (s) and 1905 (s) cm^{-1}. Since Mn(I) has an effective $3d^6$ electronic configuration, a six-covalent, spin-paired complex utilising $3d^2 4s 4p^3$ orbitals is expected to be diamagnetic. It is thus clearly an octahedral spin-paired complex of Mn (I).

74. Studies on Periodic Formation : Part III—Effect of various factors on the time and distance relationship during silver chromate precipitation in Gelatine.

A. C. CHATTERJI and R. M. BHATNAGAR, Lucknow.

The process of Liesegang ring formation during silver chromate precipitation, when silver nitrate was diffused in gelatine medium impregnated with potassium chromate, was studied under a microscope. Morse and Pierce equation (i.e. $x+\alpha/\sqrt{T}=K$, where x is the distance of the ring from the first ring, T is the time of formation, α=distance of the quasi zone and K is a constant) was verified by (a) changing the concentration of the precipitating agent, (b) varying the concentration of the diffusing electrolyte, and (c) adding the electrolyte KNO_3. The following values of K were obtained. Concentration of the Gelatine=2%.

K. values

Diffusing agent	Precipitating agent		
	N/25 K_2CrO_4	N/50 K_2CrO_4	N/50 K_2CrO_4+0·1N KNO_3
1. 0·02 grm. crystal of silver nitrate	0·0028	0·0035	0·0050
2. 0·02 ml. of 2N silver nitrate	0·0024	0·0027	0·0039
3. 0·02 ml. of 1N silver nitrate	0·0019	0·0023	0·0024
4. 0·02 ml. of 0·5N silver nitrate	0·0015	0·0016	...

From the table it is clear that the value of K decreases with the decrease in the concentration of the diffusing agent and increases with the decrease in the concentration of potassium chromate. In the presence of electrolyte (KNO_3) the values of K decreases with decrease in the concentration of silver nitrate.

The plot of X against $\sqrt{T}$ was linear; the slope increased with decrease in the concentration of the diffusing electrolyte. Attempts were made to check the validity of other equations.

75. Spectrophotometric Studies on the Zirconium Complex of 2-(3, 6-Disulfo-8-hydroxynaphthylazo)-1, 8-dihydroxynaphthalene-3, 6-disulfonic Acid.

SACHINDRA KUMAR DATTA and SACHINDRA NATH SAHA, Coochbehar.

A chromotropic azo dye: 2-(3, 6-disulfo-8-hydroxynaphthylazo)-1, 8-dihydroxynaphthalene-3, 6-disulfonic acid, abbreviated as DSNADNS has been prepared from 1-amino-8-naphthol-3, 6-disulfonic acid and chromotropic acid. This dye has been employed earlier for the spectrophotometric determination of thorium. The dye also forms a bluish-violet insoluble complex with zirconium at high acid concentration. The precipitation of zirconium complex being quantitative under specific conditions, the dye may be adopted for the gravimetric determination of zirconium. The violet complex of zirconium is insoluble in all organic solvents commonly used for solvent extraction work but is soluble in a number of liquid organic bases and solutions of ammonium salts in water showing pink to violet colouration.. Spectrophotometric studies as to the nature of the complex in pyridine, triethanolamine ammonium acetate, oxalate and carbonate solutions have been made with a view to develop analytical applications of these materials. The zirconium chelate in most of the ammonium salts and also in pyridine solution exhibit very similar absorption spectra which are almost identical to those of the free dye in such solvents, indicating thereby a decomposition of the complex in such solutions. But the solutions of the complex in ammonium carbonate and triethanolamine appear to be fairly stable. The absorbance peaks of the dye in these solutions occur at 500 and 520 mμ respectively, while the complex in triethanolamine and ammonium carbonate both shows absorbance maxima at 540 mμ. The solution of the complex in these two solvents obeys Beer's law within concentration range 4 to 25 mg. of zirconium per litre. The molar absorbance coefficients of the complex in triethanolamine and ammonium carbonate are respectively 686 and 823, which indicate poor sensitivity. The solution of the complex in the former is more stable than that in the latter. An analytical procedure for the spectrophotometric determination of zirconium, with little interference from foreign ions, in triethanolamine has been developed.

76. Complex formation between Uranyl Acetate and Gluconic Acid.

S. S. LAL, Saugor.

The complex formation between uranyl ions and gluconic acid was studied following the Hob's method of continuous variation and also the monovariation method. The stoichiometry of the complex was determined by continuous variation method using three different sets of equimolar solutions of uranyl acetate and gluconic acid, namely, M/20, M/30 and M/40. The index property used was conductivity. Both conductance and pH measurements were taken in the case of the monovariation method. The experimental results were in complete accord and established the formation of a 1 : 1 complex between uranyl and gluconate ions. The complex may be represented by the formula ($UO_2.C_6H_{10}O_7$).

77. Studies in the complex formation of Thallium compounds with Thiourea. Part I. Complex compounds of Thallous Nitrate ($T1NO_3$), Thallous Nitrite ($T1NO_2$), and Thallous Hyponitrite (T1NO), with Thiourea.

V. T. OZA and C. J. TRIVEDI, Visnagar.

No attempt has been made in the past to prepare complex salts of hyponitrites. It is a well known observation that when a solution of thiourea is added to a solution of silver nitrate white precipitate soluble in excess is obtained which slowly turns brown on standing. Same observation is met with the solution silver nitrite but the brown or black precipitate results in slightly more quicker manner. However if a solution of thiourea is added to a freshly precipitated silver hyponitrite in water free from any impurity a black precipitate is immediately formed. at room temperature.

Complexes formed by addition of thiourea solution to the solutions of thallous nitrate, thallous nitrite, and thallous hyponitrite are crystalline needle shaped compounds. Out of these three complexes only one having the formula $T1NO_3$.4tu. is known. From the thallium content determination it is found that the rest of these three compounds have also the same general formulae $T1NO_2$.4tu. and T1NO.4tu., respectively. Nitrate and nitrite complexes are stable in hot solutions and can be easily recrystallised from the same, while the last one is unstable in hot solution decomposing into thallous sulphide, which probably shows that it has got a dimeric formula.

78. Thermal Decomposition of Thallous Hyponitrite.

V. T. OZA and C. J. TRIVEDI, Visnagar

The Thermal decomposition of Thallous Hyponitrite is not investigated in past. The following are the important observations :

(1) It begins to decompose at 156°C but very slowly.

(2) When heated between 100°C and 140°C it changes its colour from orange yellow to brownish black, and during this change no decomposition takes place.

(3) In solubilities etc., it is the only hyponitrite which is appreciably soluble in water next to alkali hyponitrites. Its solution is only freely hydrolysed in water at room temperature, the hydrolysis is appreciable at high temperature.

(4) Its purity can be estimated by titrations with mineral acids as it could be done with sodium hyponitrite, but titration can be carried out at room temperature.

79. Use of Bright Platinum as Indicator Electrode in Manganic Sulphate Solution —Study of the Precipitation Reactions.

MOHD. AJMAL and WAHID U. MALIK, Aligarh.

The ferro-ferricyanide couple, usually employed for carrying out potentiometric titrations between the metal ions and alkali ferrocyanides can be dispensed with, while investigating the Mn (iii) ferrocyanogen complexes. It was found that bright platinum wire dipped in Mn (iii) solution works satisfactorily as an indicator electrode, sharp inflexions being realised both in aqueous and the non-aqueous media. Direct titrations (K_4 $Fecy_6$ in the cell) give two breaks (1 : 1 and 3 : 2 for the ratio Mn^{3+} : $Fecy_6^{4-}$), while the reverse only give one break (1 : 1). Evidence for the formation of the complex $\overset{III}{Mn}\ \overset{III}{Fecy_6}$ and the presence of the complex anion $Mn(SO_4)_2^-$ could be obtained on the basis of these titrations.

80. Chelate formation between Beryllium (II) and Sulpho-dichloro Hydroxy-dimethyl Fuchson Dicarboxylic Acid (Trisodium Salt): Studies in the Composition and Stability.

SURESH C. SRIVASTAVA and ARUN K. DEY, Allahabad.

Sulpho-dichloro hydroxy-dimethyl fuchson di-carboxylic acid (tri-sodium salt) which is commonly known as Chrome Azurol S, has been observed to yield very stable coloured chelates in solution with a number of metal ions. Beryllium (II) also forms a violet coloured chelate with Chrome Azurol S (λ_{max} 540 mμ). The composition and stability of the above chelate have been studied in detail using absorbance as well as electrical conductance measurements.

The composition as determined by (i) the method of continuous variations, (ii) mole ratio method, and (iii) the slope ratio method comes out to be 1 : 1 (Metal : Chelating agent). The colour of the chelate is stable between pH 4·5 and 7·5.

The value of stability (log K), as determined by two methods using absorbance data is $4{\cdot}4 \pm 0{\cdot}1$ and $4{\cdot}7 \pm 0{\cdot}4$ respectively, at temperature 30°C, pH 6·0 and ionic strength 0·1. The free energy change of formation corresponding to the two values of log K has been evaluated to be $-6{\cdot}18 \pm 0{\cdot}2$ and $-6{\cdot}5 \pm 0{\cdot}5$ K Cals. respectively. Suggestions have also been advanced on the possible position of the chelate ring in the complex.

PHYSICAL

81. Kinetics of the Hydrolysis of Polyphosphates—I. Pyrophosphate.

H. C. MALHOTRA and D. V. S. JAIN, Delhi.

The kinetics of the hydrolysis of pyrophosphate has been studied under different conditions of pH (1—7) temperature (50°—75°C) and ionic strength (0·1 to

1·5). The rate of hydrolysis is found to be first order in pyrophosphate but it is not a simple function of the hydrogen ion concentration. The rate is decreased with the increase of ionic strength. Activation energy and pre-exponential factor for the over-all reaction are also evaluated.

82. Kinetics of the Hydrolysis of Polyphosphate—II. (The role of H+ in the hydrolysis of pyrophosphates).

H. C. MALHOTRA and D. V. S. JAIN, Delhi

The rate of hydrolysis of pyrophosphate has been shown to depend on the pH of the solution. However, the rate is not a simple function of the H+ ion concentration and the H+ ion does not act as a catalyst in the ordinary sense. It has been shown that the rate of hydrolysis depends on the concentrations of $H_4P_2O_7$, $H_3P_2O_7^{-1}$, $H_2P_2O_7^{-2}$, $HP_2O_7^{-3}$, $P_2O_7^{-4}$. From the knowledge of the dissociation constants of $H_4P_2O_7$, the concentration of each species is estimated and the rate constants for the hydrolysis of the individual anions calculated. An estimate of the activation energies of the various reactions in the system has also been made and the data is in complete agreement with the proposed mechanism.

83. Reduction of Eosin at Dropping Mercury Electrode.

N. R. BANNERJEE and B. B. BHATTA, Delhi.

The reduction of eosin has been followed polarographically in aqueous as well as alcoholic solutions at the dropping mercury electrode. Current voltage curves of 10^{-3} to 10^{-4}M solutions were obtained using a Cambridge pen-recording polarograph with a quiet mercury pool as the reference electrode. Between $-1{\cdot}25$ and $-1{\cdot}5$ volts, the waves showed a well-defined diffusion plateau. The diffusion current was proportional to the concentration of eosin and was dependent on the height of the mercury column. It was found that the reduction of eosin involved only one electron. The following mechanism of the reduction is suggested :

Eosin forms an oxonium ion giving the molecule an orthoquinonoid structure. The oxygen which is the seat of positive charge in the ion, is attacked at the D.M.E. and is reduced. Half wave potential was found to shift to more negative values with increasing pH of the solution till neutrality was reached and it then receded slowly to less negative values as alkalinity increased. At about pH 13, evidence for alkali fission was seen in the C-V curve : two diffusion plateaus were obtained, one due to eosin and the other, to a fission product or products.

84. Strength of Sulphonic acids and their use as titrants in acetic acid and fluorosulphonic acid—Part I.

RAM CHAND PAUL, KAILASH CHANDER MALHOTRA, SARVISIDER SINGH PAHIL and SHAM KUMAR VASISHT, Chandigarh.

Determinnation of equivalent conductivity of fluorosulphonic acid in acetic acid has revealed that it is a strong protonic acid with strength comparable to that of perchloric acid. It has been developed as an acid in this medium by carrying out conductometric, potentiometric and visual titrations using crystal violet and malachite green as internal indicators.

85. The Chemistry of Protoactinium : II : Paper Electrophoresis in HCl solutions.

C. GOPINATHAN, K. S. VENKATESWARLU and J. SHANKAR, Bombay.

A semi closed type of apparatus has been designed for use in electrophoresis studies of Pa-233 in HCl solutions. These experiments indicated that the protoactinium containing anions to cations ratio increases as HCl concentration is changed from 3·5 to 6·0 M. From log (anion/cation) against log a ±HCl graphs one can postulate the nature of cation to anion conversions involved. The mobility of Pa-233 is greatly enhanced by the presence of traces of fluoride ion, and the histograms indicated the presence of a clear cationic species.

86. X-ray studies of Neutron Irradiated Calcite and Gypsum.

J. M. LUTHRA and J. SHANKAR, Bombay.

Warren and Averbach's method has been used to separate the particle size and strain effects in the case of neutron irradiated calcite and gypsum. It has been observed that calcite shows line broadening while gypsum shows only lattice expansion along the b axis. These differences in behaviour towards radiation have been discussed in the light of their structure and bonding.

87. An Electrochromatographic study of the nature and number of species formed as a consequence of (n, γ) reaction in Sodium Ethylene Diaminetetra-acetato CO (III).

J. SHANKAR, K. S. VENKATESWARLU and R. SHANKER, Bombay.

Paper electrophoresis of neutron irradiated sodium ethylene diamine tetra-acetato CO (III) indicated that besides the parent complex anion and CO++, other neutral and positively charged species are also present. The yield of the various species depends upon the pH of the electrophoresis run. This is true even of thermally annealed samples. The increase in the yield of the parent complex can be explained as due to fast, pH dependent reactions of the degradation products when the irradiated solid is dissolved.

88. Ion Exchange studies in Non-aqueous Solvents.

J. SHANKAR and M. R. GHATE, Bombay.

Ion exchange equilibrium studies between lithium and hydrogen on Amberlite IR-120 and Dower-50, (Sulphonated polystyrene type cation exchangers) have been studied in aqueous, 25% and 50% acetone-water media (by volume). The equilibrium quotients have been determined over the whole range of resin compositions. The difference between the equilibrium quotients in different media has been explained on the assumption that the resin phase activity coefficients do not play an important role under the conditions employed. The activity coefficients of lithium and hydrogen in 25% and 50% acetone-water media at 0·1 M ionic strength have been computed.

89. Kinetics and Mechanism of Cation Exchange Reactions in presence of complexing agents.

J. SHANKAR and T. R. BHAT, Bombay.

Kinetics of the $NH_4^+-Cu^{+2}$ and $NH_4^+-Nd^{+3}$ exchange on cation exchange resin were studied in the presence and in the absence of complexing agent (EDTA) in the concentration range of less than 0·1N. While the total exchange rate increased by the presence of EDTA the rate of attainment of equilibrium was reduced. In the absence of complexing agent the film diffusion of Cu^{+2} and Nd^{+3} were found to adversely affect exchange rate whereas in the presence of EDTA the film diffusion of NH^{+4} was the major rate determining step. Kinetics of the displacement of copper by NdY^-, in the presence of NH_4^+, was also studied and the different rate controlling steps were discussed.

90. Nature of the species formed on dissolution of Trisacetylacetone CO (III) after (n, γ) reaction in solid state.

J. SHANKAR, MANOHARLAL and K. S. VENKATESWARLU, Bombay.

Paper electrophoresis studies of neutron irradiated tris-acetylacetone CO(III) are described in this communication. Two distinct peaks are observed, which are identified to be due to the parent complex and CO^{+2}. In all cases, including samples diluted with the isomorphous rhodium and aluminium complexes, the parent species moves a little towards the negative side of the histogram indicating a small associated positive charge. Thermal annealing for four hours at 100°C resulted in a perfectly neutral parent species. On dissolution of irradiated tris-acetylacetone CO(III) in acetylacetone, before the chemical separation resulted in an increase in retention. This can be explained as due to the presence of radical deficient positive species.

91. Isotopic Exchange in the Cobaltous-cobaltic system (III) effect of certain Ions.

J. SHANKAR and B. C. DESOUZA, Bombay.

The effect of certain common ions on the exchange rate in this system has been studied. The effect of the sulfate ion has been studied in detail and the $\triangle^{\ddagger}H$ and $\triangle S^{\ddagger}$ values were found to be $11{\cdot}6 \pm 2$ KCals and -13 ± 7 eu. at ionic strength $=2{\cdot}0$. The formation constant for the specie $COSO_4^+$ was found to be $16f^{-1}$ at 0°C and ionic strength $=2{\cdot}0$, and the $\triangle H$ and $\triangle S$ values were $0{\cdot}0 \pm 1{\cdot}6$ KCals and $1{\cdot}8 \pm 0{\cdot}6$ eu. respectively. The nitrate ion was also found to accelerate the exchange and the formation constant for the specie $(CoNO_3^{+2}$ was $0{\cdot}39 \pm 0{\cdot}09f^{-1}$ at 0°C and ionic strength $=1{\cdot}0$. The fluoride ion showed no effect on the exchange rate in the concentration range of $1{\cdot}6 \times 10^{-3}$ to $5{\cdot}0 \times 10^{-2}$ NaF (f). Chloride and thiocyanate ions were rapidly oxidized by the cobaltic ions. The Ag^+ causes a large increase in reaction rate.

The probable mode of participation of these ions in the exchange mechanism has been discussed.

92. Some theoretical aspects on the retaining bed used in displacement Chromatography in the presence of EDTA.

J. SHANKAR and T. R. BHAT, Bombay.

Some theoretical aspects of the retaining bed used in displacement chromatography in the presence of complexing agents are discussed in detail. A theoretical method is given and limiting conditions are arrived at by which it will be possible to predict whether a particular retaining bed will be successful under given experimental conditions, from a knowledge of the physical constants such as, the ion exchange equilibrium constant of the uncomplexed cations and the stability constants of the complexes formed by the cations with the eluant. The predicted elution behaviour of a number divalent and trivalent cations with EDTA as eluant are found to agree with the experimental results.

92. (a) Rheochor of Binary mixtures.

H. G. SILAWAT and W. V. BHAGWAT, Indore.

It has been observed that the Mixture Law is applicable to Rheochor in case of non-associated binary mixtures. Following mixtures were investigoted :—

(a) Methyl ethyl ketone-Toluene.
(b) Benzene-Carbon tetrachloride.
(c) Methyl ethyl ketone-carbon tetrachloride.
(d) Benzene-Chloroform.
(e) Benzene-Acetone.
(f) Methyl ethylketone-Chloroform.
(g) Carbon tetrachloride-Ethyl alcohol, and
(h) Toluene-Ethyl alcohol.

93. Effect of Sesquioxides on the Cation Exchange Capacities of Soil Clays.

T. D. BISWAS and S. P. GAWANDE, New Delhi.

Soil clays contain variable amounts of free sesquioxides removal of which by the hydrosulphite (sodium dithionate) method of Mackenzie (*J. Soil Sci.* **1** : 121-220, 1954) was found to affect their cation exchange capacities in case of clay fractions separated from the soils in a catenary sequence which consists of soils ranging from the well drained acidic soils to alkaline soils formed under impeded drainage conditions. The clay fractions of the well drained soils contained illite as the dominant clay mineral with traces of kaolinite and vermiculite whereas in the clays from impeded drained soils, montmorillonite was the dominant clay mineral. The former clays contain about 6 to 10 per cent of free ferric oxide whereas the latter contain about 4 per cent. Free alumina is practical uniform.

In the case of clays from the well drained acidic soils, the cation exchange capacity increased on the removal of free sesquioxides, by about 30 to 40 per cent as compared to the original clay whereas in the case of clays from poorly drained soils, cation exchange capacities decreased by about 10 per cent as compared to the original untreated clay. In the former case, it appears that the free ferric oxide might have blocked the active spots of ion exchange in the absence of which some more spots are available for exchange or else the dilute hydrochloric acid treatment in the process of removal of free oxides might have removed the interlayer aluminium of the clay mineral, thus causing significant increase in cation exchange capacity of the clays. In the latter case, the treatment must have attacked the clay lattice, thereby decreasing the cation exchange capacity.

94. Catalytic Decomposition of H_2O_2 by Kohlschüter's Silver Sol.

VIRENDRA SINGH and S. P. MUSHRAN, Allahabad.

Catalytic activity of Kohlschütter's silver sol has been investigated towards the decomposition of aqueous hydrogen peroxide. The rate of decomposition of hydrogen peroxide was followed by titrating the undecomposed hydrogen peroxide with a standard solution of potassium permanganate in presence of H_2SO_4. It has been observed that order of decomposition changes with the concentration of hydrogen peroxide and tends to decrease with the increasing concentration of hydrogen peroxide. Percentage decomposition has also been found to decrease with the increasing concentration of H_2O_2.

The temperature coefficient and energy of activation have been calculated. The energy of activation is low as for all catalysed reactions than uncatalysed one.

The experimental results are explained on Haber-Weiss mechanism for decomposition of hydrogen peroxide.

95. An Ionic Model for Gaseous metallic diatomic oxides to calculate electronic free energy functions.

M. S. CHANDRASEKHARAIAH, Dharwar.

A simple ionic model for gaseous metallic monoxides is proposed. Using this model, electronic free energy functions for these gaseous oxides are calculated. In calculating rotational and vibrational partition functions, available spectroscopic data are used and whenever such data are not available, estimated values are used. Method of estimating the rotational and vibrational constants are described. Tabulation of the total free energy functions for MO (g) is presented.

96. Faradaic Admittance and Absorption—A diffusion model.

S. K. RANGARAJAN and K. S. G. DOSS, Karaikudi.

When diffusion alone is the mode of mass transfer, expression have been derived previously for the elements of the faradaic admittance which predict that its phase angle cannot exceed $\pi/4$. Several systems show the possibility of the phase angle being greater than $\pi/4$. Laitinen and Randles had suggested that such anomalous behaviour can be explained by taking into account the correction for the contribution of the adsorbed reactants. A different model, based on diffusion, is presented in this paper and shows how the conclusions of Laitinen and Randles (e.g., the elements of the equivalent circuit, R_a and C_a, are independent of frequency) can be obtained through this model too. A detailed comparison between the parameters used in the two diflerent models are made. Results for a generalised diffusion model are cited.

97. Anodic Polarisation studies on formation and breakdown of Oxide Films in aqueous solutions. Part I: NaOH-NaCl system.

K. S. RAJAGOPALAN, (MISS) K. VENU and K. BALAKRISHNAN, Karaikudi.

The conditions under which protective oxide film formation or passivation will take place in solutions containing different amounts of corrosive (NaCl) and inhibitive (NaOH) constituents are of intetrest from the practical point of view e.g., protection to reinforcements by concrete. An elegant method of studying oxide film formation is the measurement of changes in potentials following the application of a fixed current density. The appropriate current density for studying the above system, differences in anodic polarisation behaviour of corrosive and inhibitive systems, the ratios at which the two constituents should be present for passivation to take place are considered in this paper.

98. Anodic Polarisation studies on formation and breakdown of Oxide Films in aqueous Solution. Part II : K_2CrO_4-NaCl system.

K. S. RAJAGOPALAN and (MISS) K. VENU, Karaikudi.

Potassium chromate is very commonly used as a corrosion inhibitor in neutral solutions. But the behaviour of chromate ions becomes unpredictable if chloride ions are also present in the system. It is shown that the relative concentrations in which the two types of ions should be present in solution can be correctly predicated by anodic polarisation measurements at a current density which is the characteristic of the system.

99. Anodic Polarisation studies on formation and breakdown of Oxide Films in aqueous solutions. Part III : Sodium Benzoate-NaCl system.

K. S. RAJAGOPALAN and (MISS) K. VENU, Karaikudi.

Sodium benzoate has been shown to be a corrosion inhibitor in neutral solutions. It is not an oxidising agent like chromate. It is of interest to examine at what concentrations of sodium chloride, sodium benzoate can give protection to steel. The appropriate ratios of benzoate and chloride have been determined by the method described earlier. These ratios are discussed in relation to similar ratios for hydroxyl and chloride, and chromate and chloride.

100. Viscosity of Barium Bromide in Dioxane-water Mixtures at 35°C.

P. B. DAS and D. PATNAIK, Cuttack.

The measurements of viscosity of barium bromide in dioxane-water mixtures have been carried out for verifying the modified form of the Jones-Dole equation. (Curr. Sci. 1956, **25**, 337). The concentration of the electrolyte varied from 0·001 to 0·100 M and the solvent composition from 10% of dioxane to 30% of dioxane content by weight. The Jones-Dole equation is found to be inadequate and the experimental data fit in well with the modified equation. The value of 'B' has been found as before to be dependent on the solvent composition.

101. Determination of diffusion coefficient of ferric ions in supporting electrolyte.

H. P. AGARWAL and (MISS) U. RAUT, Bhopal.

In the present work the rate of diffusion of ferric ion in 1-N sulphuric acid was studied using a fritted glass diaphragm cell. In one arm of the cell, solution of known concentration of ferric ammonium sulphate in 1-N sulphuric acid was taken and the amount diffused in another arm of the cell containing the supportig electrolyte (1-N H_2SO_4) was studied by the electro-chemical method. To avoid concentration gradient, the ferric solution in the first arm of the cell was stirred using a mechanical stirrer. The diffusion coefficient of ferric ion at a concentration of ·002 M and ·005 M in 1-N sulphuric acid is $\cdot 512 \times 10^{-6}$ cm.^{2} sec.$^{-1}$ and $\cdot 338 \times 10^{-6}$ cm^2 sec^{-1} respectively at a temperature of 20°C. The method can be extended for determination of diffusion coefficients of other ions in different supporting electrolytes.

102. A search for seat of Negative Joshi Effect.

B. M. JAISWAL and A. R. SIDDHANTY, Indore.

Theories for negative Joshi effect, △i, ascribe it to 1. Volume origin or 2. Electrode surface origin. Studies have been made in Geissler tubes, but there i could not be detected. When one glass electrode was provided by wrapping copper wire sleeve on the glass wall, △i was detected in the same tube. This hows that the seat of △i is in the glass electrode surface.

103. High Serial Impedance—A condition favourable for occurrence of positive Joshi Effect.

B. M. JAISWAL, Indore.

Studies of potential variation of Joshi Effect have been carried out in an zoniser containing sulphur vapour. It is found that when LC (Negligible esistance) is ued in series with the ozoniser, positive Joshi effect could not be etected in spite of efforts. When the LC is replaced by pure ohmic resistances f the order of a few thousand ohms, in the same tube under same conditions, ositive Joshi effect was detected. It increased with increase in serial resistance. This observation points out that high serial impedance constitutes a condition avourable for occurrence of positive Joshi effect. The cause appears to be the essening of the effective applied potential on the ozoniser due to the distribution f total applied potential between (1) Ozoniser and (2) Serial resistance.

When serial resistances are very high, no current flows in dark or in light, t lower applied potentials and so positive effect is absent. At higher applied otentials, negative effect is observed. These observations are also discussed in light of the above views.

104. Evidence of Le Chatilier's Principle Holding in Electrical Discharges in gases.

B. M. JAISWAL, Indore.

When electrical discharge is taking place in a gas, there exists a sort of quilibrium between the neutral molecules and/or atoms and ions and electrons, pending upon the value of the applied potential. The threshold potential Vm, s a special significance of being lowest potential at which this equilibrium can xist.

The studies reported, have been carried out in Geissler tubes of same dimensions. 1) It is found that Vm increases with increase in pressure of the gas. (2) At onstant applied potential, the discharge current decreases with increase of gas ressure. (3) The discharge current increases by flooding the Geissler tube with hotons. All these observations are in conformity with Le Chatelier's principle and therefore point out that it holds in electrical discharges in gases.

05. Conductivity of Potassium Chloride, Sodium Chloride and Sodium Bromide in Methanol-water Mixture at 35°C.

B. PANDA, P. B. DAS and B. NAYAK, Cuttack.

Conductance of potassium chloride, sodium chloride and sodium bromide in methanol-water (74 : 24 w/w) have been measured at 35°C. The equivalent conductance at zero concentration and the dissociation constants have been determined by using the methods of Fuoss & Kraus and that of Shedlovsky. The values obtained by the two methods are in good agreement. The diameter of the ion pairs have also been calculated, employing Bjerrum's and Stoke's methods.

106. Studies in Membrane permeability Activation Energy of diffusion of various electrolytes through Chromic ferro and ferricyanides.

FASIH A. SIDDIQUI and WAHID U. MALIK, Aligarh.

To elucidate the factors responsible or the differential rates of permeation of various ions through inorganic membrane, the permeability of various electrolytes through chromic ferro and ferricyanides at different temperatures were determined.

The order of permeability of potassium salts was KCl $>$ KNO_3 $>$ K_2SO_4 and for sodium salts NaCl $>$ $NaNO_3$ $>$ Na_2SO_4 for both chromic ferro and ferricyanide membranes. The ratio of Cl'/SO''_4=was 2·2 showing thereby that the valency factor is also responsible for the permeability of various electrolytes. The energy of activation was determined for various electrolytes by plotting log $(p \times 10^2)$ against $1/T \times 10^3$. It was found that the values were greater than for the free diffusion, confirming thereby that the membrane barrier is mainly electrostatic and the energy barrier which the ions have to surmount in passing through the membrane must be greater than for the free diffusion.

107. Polarography of Heavy metal Soaps—Behaviour of Nickel palmitate and Myristate at the Dropping Mercury electrode in non-aqueous media.

RIZWANUL HAQUE and WAHID U. MALIK, Aligarh.

Polarographic studies of the pyridine complexes of Nickel palmitate and myristate were carried out in non-aqueous media using (1) Lithium chloride in 50% benezene methanol mixture, (2) Methyl hydrogen sulphate in 50% benzene methanol mixture and (3) Potassium chloride in ethylene glycol. It was found that both the complexes are reduced reversibly at the dropping mercury electrode and the reduction takes place with one electron transfer. The wave height was found to be dependent upon the concentration of the soap solution, the values of i_d being directly proportional to the concentration of the metal ion. From the studies it was concluded that the polarographic method can be employed for the estimation of the metal ion in these soaps.

108. Spectrophotometric and Conductometric investigations on Cu(i)-di sodium 1:8 dihydroxy naphthalene 3:6 disulphonate (Chromotropic salt) Chelate.

S. M. FAZLUR REHMAN and ANEES UDDIN MALIK, Aligarh.

The chromotropic acid (sodium salt) has been found to form with cuprous ions a pink coloured chelate. The nature and the composition of the chelate has been investigated by spectrophotometric and conductometric methods. The chelate has the composition Cu_2 (DNS) and λ_{max} lies at 430 mμ. It is stable between pH 5·0 and pH 7·0. The values of formation constant K and $\triangle F^{\circ}$ are $2{\cdot}1 \times 10^4$ and $-2{\cdot}58$ K Cals at 30°C respectively.

109. Study of the reaction between Potassium Ferrocyanide and Nitrobenzene with and without the presence of Cr+++.

G. P. SHARMAKAPHLEY and WAHID U. MALIK, Aligarh.

Experiments on the interaction of chromic chloride and potasium ferrocyanide have provided enough evidence for the decomposition of potassium ferrocyanide to potassium ferro-aqua-penta-cyanide.

$$K_4\,Fecy_6 \underset{H_2O}{\overset{H_2O}{\rightleftharpoons}} K_3\,Fecy_5\,H_2O$$

Preliminary experiment of the Kinetics of decomposition were carried out by absorption studies by obtaining the nitroso-benzene complex (violet in colour).

It was found that the presence of Cr ions in very small quantities $(10^{-4}M)$ is sufficient to develop the violet colour, whose intensity increases with the lapse of time. The reaction was found to be dependent on the concentration of Cr+++ ions up to a certain concentration, the O.D. values remaining almost constant after reaching a certain maximum values. The reaction was also found to be dependent upon the concentration of nitroso-benzene. Exposure to ultra-violet light helps in attaining the equilibrium quickly.

110. Intrinsic Viscosity Temperature Studies of Potato Amylose Acetate.

R. D. PATEL and R. S. PATEL, Gujarat.

The viscosity of the three fractions of amylose acetate of potato starch is studied in chloroform and a mixture of chloroform and cyclohexane at different temperatures. From the results, the parameter K have been determined at 32°C, 40°C and 48°C. By using these values of K, the thermodynamic parameters have been calculated.

111. The calculation of activation energy of self-diffusion in some solid metals.

RAM GOPAL, Lucknow.

A simple method for estimating the activation energy of self-diffusion Q in some solid metals, based on Pauling's concept of localised atomic orbitals in metals, is proposed. The values of Q calculated for different metals appear to be in general agreement with the available experimental data. The method developed avoids the tedious quantum-mechanical calculations and it is believed that the procedure outlined will be of general applicability.

A method for estimating the total binding energy, or lattice energy has been described. It is an extension of the method used for simple metallic system like alkali and alkaline earth metals. The method uses the Pauling's metallic valency in place of ordinary chemical valency of metals. It has been pointed out that the values of lattice energy of transition metals estimated by Ketelaar, Mott and Jones and obtained from Wilson's equation, do not conform to the physical properties of these metals and appear to be too low.

112. Relation between the lattice energy and melting point in some heavier metals.

RAM GOPAL and MOHD. MUKHTAR HUSSAIN, Lucknow.

The lattice energies ($-U_0$) of metals given by $-U_0=I\times n+S$ (where I is the ionization potential, 'n' the Pauling's metallic valency and S the latent heat of sublimation of tht metal concerned) appear to be in better correspondence with the high of the metal concerned) appear to be in better correspondence with the high melting points of transitional metals as compared to the values of $-U_0$, estimated earlier using ordinary chemical valency (i.e. the number of electrons in the valency shell) of the metals (cf. Ketelaar, Wilson, Mott and Jones. The relationship $-U_0/T_m$ has been found to be approximately constant for similar metals (in fact it is around 0·5 for many of them) and it has been shown that this ratio, calculated from the knowledge of the respective heats of fusion and specific electrical conductivities in solid and liquid states respectively, is in good agreement with those calculated directly from $-U_0$ and T_m.

A detailed comparision of the different physical properties, besides the melting points, of such metals with their respective lattice energies is under way.

113. "Studies on solutions of high dielectric canstant" partial molal volume of some uni-univalent electrolytes in formamide at 35°C.

RAM GOPAL and R. K. SRIVASTAVA, Lucknow.

In continuation with the work reported earlier (Proc. Ind. Science congress part III, 1961) on partial molal volume of uni-univalent electrolytes in formamide, attempts have been made to refine the experimental techniques to get more accurate and reliable data, before extending the study to the other systems. Pyknometers reading up to 0·0005 c.c. have been employed in the present investigation and weighings have been performed in dry atmosphere. The values of partial molal volumes ($\bar{V}o$) for KCl, KBr, KI, KNO_3, $NaNO_3$, NH_4NO_3, and NH_4Cl are 32·20, 38·15, 50·05, 43·5, 33·90, 49·55, 37·00, which are slightly higher than those reported previously*. Further, these are slightly (but definitely) higher than the corresponding values in water.

Ammonium salts show the least deviation.

114. Potentiometric study of copper (II) Triethanolamine complexes.

S. MAHAPATRA and R. S. SUBRAHMANYA, Bangalore.

A study of the nature of complexes produced in copper (II)—triethanolamine system has been made by potentiometric methods. It was found that $\bar{n}$ vs p [A] curves obtained with various concentrations of cupric ion and triethanolammonium ion titrated with sodium hydroxide did not coincide indicating polynuclear complex formation. It was also noticed that $\bar{n}$ vs p [A] curves obtained at various pH values for the same metal ion concentration also did not coincide indicating that complexes containing both triethanolamine and hydroxy groups are produced. However, when the titrations are conducted by Bjerrum technique in presence of 1·0 M triethanolammonium ion, the $\bar{n}$ vs p [A] curves coincided even at fairly high concentrations of cupric ion indicating that only mononuclear complexes are produced. The successive formation constants of MA and MA_2 as obtained from $\bar{n}$ vs p [A] curves are $10^{4.5}$ and $10^{2.6}$ respectively.

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* With S. B. Misra who has discontinued.

115. Studies on the Hydrolysis of Cupric ion.

S. MAHAPATRA and R. S. SUBRAHMANYA, Bangalore.

A study of the hydrolysis of cupric ion has been made employing various concentrations of cupric ion (10, 6, 2, 1·0, 0·5, 0·25 mM.). It is noticed that $\bar{n}$ vs p[OH] curves depend upon the concentration of potassium nitrate used to keep the ionic strength of the medium constant. The $\bar{n}$ vs p[OH] curves for various concentrations of metal ion did not coincide indicating polynuclear complex formation. Applying Sillen's 'core+links' theory it was possible to find out that $Cu_2(OH)_2{}^{++}$ is the most probable species present in the system. It has also been possible to get an ideal mononuclear curve from the experimental $\bar{n}$ vs p(OH) curves by applying limiting techniques. The constants obtained from the mononuclear curve for Cu OH+ and $Cu(OH)_2$ are $10^{6.5}$ and $10^{12.8}$ respectively. The results obtained indicate that Cu(OH)+ and $Cu(OH)_2$ will immediately get converted to $Cu_2(OH)_2{}^{++}$ according to the following scheme.

$$Cu\ (OH)_2 \rightleftharpoons Cu\ (OH)^+ + OH^-$$
$$2Cu\ (OH)^+ \rightleftharpoons Cu_2(OH)_2{}^{2+}$$

116. Studies on the coagulation of antimony and gold sols by light extinction and surface leaving techniques.

ARVIND KUMAR, AMAL K. BHATTACHARYA, and
ABANI K. BHATTACHARYA, Agra.

Antimony and Gold sols were prepared and their precipitation values were studied by KCl, $BaCl_2$ and $AlCl_3$ by employing the light extinction and the surface leaving methods in the light of the equation $C=a+\frac{m.\ 1/t.}{n+1/t.}$. Different concentrations of these electrolytes were added to the sol and the corresponding times of coagulation were determined by light extinction and visual surface leaving method. The times of coagulation by both the methods could not be expected to be indentical, because the stage of coagulation may not be the same, when different techniques are employed. The merit of this equation, however, was not affected, inasmuch as the relation between 1/C-a of electrolyte and their respective times of coagulation was found to be linear. The constants a, m, and n were determined for each electrolyte.

117. Studies in the adsorption of Hydrogen on Iron-kieselguhr powder.

C. S. SWAMY and M. R. A. RAO, Bangalore.

The adsorption of hydrogen has been studied in the temperature range of −191 to 350°C on a variety of Iron kieselguhr samples prepared by the method of impregnation. At −191°C, the hydrogen is mostly physically adsorbed both on the support and on the metal. With increase in temperature, the adsorption decreases up to 0°C. With increase in temperature, the adsorption goes on increasing up to the highest temperature studied (350°C) indicating activated adsorption of hydrogen. A maximum in the absorption isobar is, however, noticed near about 275°C.

The adsorption isotherms at temperatures of 97°C and above show a peculiar pressure dependence in that the isotherms become convex to the pressure axis above a pressure of 40 cm. Hg. This has been explained on the basis of the migration of adsorbed hydrogen atoms. This has been further confirmed by the fact that readsorption studies of hydrogen employing a Topler pump showed that the sum of the retention and readsorption at any particular temperature exceeds the original adsorption.

118. Studies on the formation of surface complexes of Hydrogen and Carbon Monoxide on Metallic iron.

K. S. NARAYAN and M. R. A. RAO, Bangalore-12.

The effect of small quantities of presorbed carbon monoxide on the subsequent adsorption of hydrogen has been studied in the temperature range of 97°C to 250°C. It has been found that at 97°C and 134°C the adsorption of hydrogen is not affected by the presence of even 1·5 c.c. of presorbed carbon monoxide. At 200°C and 250°C, on the other hand, the adsorption of hydrogen is enhanced by the presence of presorbed carbon monoxide. The enhancement of hydrogen adsorption increases with increasing quantities of presorbed carbon monoxide and also the enhancement is greater at elevated pressures. These results have been explained on the basis of the formation of surface complexes of hydrogen and carbon monoxide of varying composition ($CO : H_2$ and $CO : 2H_2$), the higher hydrogen complex being formed at 200°C and 250°C.

119. Solvent Effects on $n \longrightarrow \pi^*$ Transitions:—Evaluation of the various types of solute-solvent interactions.

A. BALASUBRAMANIAN and C. N. R. RAO, Bangalore 12.

Effect of various non-polar, polar and hydroxylic solvents on $n \longrightarrow \pi^*$ transitions have been studied in detail. The relative magnitudes of the contribution due to the refractive index term, dielectric constant term and hydrogen bonding have been evaluated. Hydrogen bond energies of different base—alcohol systems have been estimated. Evidence is presented for the equilibrium of the hydrogen-bonded species with the free species.

120. Mechanism of Crystal Structure Transformations : Studies on the Anatase-Rutile Transformation.

S. R. YOGANARASIMHAN and C. N. R. RAO, Bangalore ·12.

Variations of crystallite site, particle size, surface area and lattice dimensions accompanying the crystal structure transformation of anatase have been studied. The anatase lattice expands prior to the transformation. While surface area has negligible effect on the transformation, particle site is an important parameter. Impurities affect the transformation markedly. These studies throw light on the detailed mechanism of this crystal structure transformation.

121. Alkali Complex Ions.

S. K. K. JATKAR and Mrs. VIJAYA A. DEO, Poona.

The authors have calculated stability constants of the complex ions $M(H_2O)_4I_4{}^{3-}$ for alkali salts. Straightline graphs are obtained by plotting log Kc versus ($-\log f$) with higher values of slope, which can be obtained in theoretical value by adjusting the various parameters such as dielectric constant, distance of closest approach and water of hydration, etc.

122. Viscometric studies on 'Akli' bentonite suspensions—variation in viscosity with pH in presence of some anions.

J. P. SINGHAL and W. U. MALIK, Aligarh.

The influence of a number of anions on the viscosity of a dilute suspension of 'Akli' bentonite was studied. The results reveal not only a great tendency of the clay to undergo gelation but the existence of a definite lyotropic series in bringing about solvation. Experiments performed on the variations in viscosity with pH for bentonite suspensions containing a fixed amount of the anions show that the maxima and minima in the pH—viscosity curves appear at more or less the same pH (maxima pH $\approx$10; minima pH$\approx$ 11). However, the absolute values of the viscosity differ from electrolyte to electrolyte. Here again the existence of a lyotropic series is found, the order being,

$$\text{Citrate} > SO_4 > ClO_3 > CNS > NO_3 > Cl$$

It has been visualised that the latter behaviour can be employed in characterising clay minerals.

123. Infrared and Raman Spectra of Polyatomic molecules and Dipole moments.

S. K. K. JATKAR and N. C. GUJERATHI, Poona-7.

The theories of infrared and Raman spectra of polyatomic molecules are based on the various fundamental modes of longitudinal and bending vibrations. The excess of lines in the spectra over 3n-6 are usually explained on the basis of harmonics and combinations of the fundamental frequencies, although there is no satisfactory agreement between the calculated and observed values. In the present paper the authors have shown that the spectra originate from dipolar bonds and their inductive contributions on each other by the component law postulated by Jatkar.

A study of the main spectra of water in vapour, liquid and ice, shows that there are two types of molecules with 104°.30′ and 109°28′ as $H\hat{O}H$ angles. The study of the spectra of hydrogen peroxide shows that the nature of the OH bond and the inductive contributions is also given by component law. The various dipole moments of the bonds show a straightline relationship with the infrared and Raman frequencies.

124. Electrophoretic velocity by the boundary method and measurement of the internal variations of potential or current by electronic technique.

P. D. BHATNAGAR, Agra.

The paper deals with the introduction of electronic systems in the electrophoretic determinations by the boundary method. Constant voltage and constant current supplies based on electronic circuits have been described as against those based on mechanical means as used by the previous workers in this field. A new and more accurate system of measuring changing voltages developed by combining the merits of a potentiometer and a vacuum tube voltmeter has also been described. It has been pointed out on theoretical grounds that the electrophoretic studies under constant current conditions will be more cogent for heterogeneous systems like colloids under study.

125. Transference number of the phosphoric and nitric acid by moving boundary method.

R. D. SRIVASTAVA and K. BANERJEE, Lucknow.

The transference numbers of nitric and phosphoric acids have been determined before by several methods at 25°C and 20°C only. We have determined these values at 50°C and 40°C and in several concentrations. We have also studied the effect of the variation of the concentration of solutions on the transference numbers in these acids. Our method of approach towards the problem was similar to Kerker, and coworkers (Trans. Faraday Soc. *56*,1039, 1960 and *57*, 781, 1961). Each set was repeated at least three to four times till constant result is obtained.

From the data obtained limiting transference number was evaluated by extrapolation and the values of calculated. The results were in conformity with the values of limiting equivalence cited in the literature. It was also noticed that the transference numbers decrease with the rise of temperature and that its value changes with the change in concentration of the solution and attains constancy near the value which is predicted by Kohlrausch's regulating function. At higher concentration it was noticed that the moving boundary method fails to give consistent result, which supports the observation made by Kerker.

126. Studies on the system, $CuSo_4$-$(NH_4)_2SO_4$-H_2O Cupric Sulphato complexes.

P. R. KRISHNAN and A. C. CHATTERJI, Lucknow.

The above system was investigated over a wide range of concentration spectrphotometrically both in the visible as well as in the ultraviolet region. Complexion formation between $CuSO_4$ and $(NH_4)_2SO_4$ at ratios 1 :1, 1 :2, 1 :3, 1 :5 and 1 :6 was indicated. The Bathochromic shifts in the visible region point to the interaction of the ligand field. With the weak d-d transitions on the Cu++ ion. Whereas, if an ion pair of the type $(Mx(H_2O)I_4)$ were involved, the ligand would be too far away from the metal ion to affect its visible spectra. The fact that the same five maxima were evident at five distinct wave-lengths in the u.v. region conclusively rules out the existence of polynuclear complexes. The u.v. spectra have been interpreted in terms of charge transfer spectra, the electron from SO_4 reduces Cu++ to Cu+.

A potentiometric study of the above system, using copper and gum electrodes confirmed complex-ion-formation at the above ratios. The stability constants as well as the thermodynamic constant for the complex ions, were determined.

127. Physical Studies of Proteins. Part I—Potentiometric determination of the Binding of chloride ion with gelatin.

SALAHUDDIN and WAHIDA MALIK, Aligarh.

The binding of the chloride ions with gelatin, studied potentiometrically by titrating against aluminium chloride and hydrochloric acid revealed the following interesting informations.

The chloride ion binding although small is appreciably influenced by pH. In the case of aluminium chloride, the chloride ion bound increases on decreasing the pH from 4·24 to 2·4, whereas a similar behaviour is observed in the case of hydrochloride acid for pH change from 11·32 to 10·00. These results suggest that the binding is dependent both upon the initial concentration of the chloride ion as well as the pH. At lower pH values the number of positive nitrogen in the protein-structure increases due to the reaction

$$-NH_2+H+=-NH_3+$$

thereby increasing the uptake of chloride ion by gelatin.

128. Polarographic study of complex formation between Fe(II) and thiomalic acid.

(Km.) UMA KAPOOR and H. L. NIGAM, Allahabad.

Polarographic study of the reaction between Fe(II) and thiomalic acid (TMA) has been made in borax buffer (pH 9), phosphate buffer (pH 7) and acetate buffer (pH 5).

The observations on anodic and cathodic currents indicate a 1 : 1 complex formation between Fe(II) and thiomalic acid.

129. A study of kinetics of bromination of cinnamic acid and its derivatives (Part II) in different solvents.

A. N. BOSE and V. K. SETH, Lucknow.

The bromination of cinnamic acid and its derivatives were studied in different solvents as carbon tetrachloride, benzene, nitrobenzene and methyl alcohol. The rate of reaction at different temperatures and energy of activation were calculated. With the help of these the values of other thermodynamic constant were calculated. In the case of cinnamic acid the rate of reaction in different solvents were found to be of following order. Methyl alcohol ⟩ Nitrobenzene ⟩ Carbon tetrachloride ⟩ Benzene. In the case of p- isopropyl cinnamic acid the order of rate of reaction in these solvents were different. It was of the form Methyl alcohol ⟩ Nitrobenzene ⟩ Benzene ⟩ Carbon tetrachloride. No definite reason, as yet, can be attributed to the change in the rate of reaction studied in different solvents.

It was not possible to derive any order for the solvents in the case of p- methyl cinnamic acid, as solutions of this acid could not be prepared of the concentration, at which rate of reaction of other acids have been determined.

Frequently factor (PZ), entropy of activation (S*) and free energy of activation (F*) were found to be changing with the change in solvents. These factors directly affect the rate of reaction. When methyl alcohol was used as a solvent for all the compounds, these factors were found to be more or less constant throughout the series.

130. Relative stabilities of certain metal pyridine thiocyanate complexes.

G. S. RAO and A. D. DAMODARAN, Bombay.

The thermodynamic properties $\triangle$ F, $\triangle$ H and $\triangle$ S have been calculated for the pyridine thiocynate complexes of cobalt, nickel, zinc and copper from their dissociation pressures. The relative stabilities of these complexes have been discussed in the light of the above data and found to be in the order Co ⟩ Ni ⟩ Zn ⟩ Cu.

131. Solvent Effect on Lifetimes of fluorescent Compounds.

MISS K. K. ROHATGI, Calcutta.

Absorption spectra of fluorescein (1 000$\times 10^{-4}$ M) in alkaline media have been studied in a number of 90% v/$_{\mathrm{v}}$hydroxylated solvents such as water, series of primary alcohols and glycerol. ν_{max} is found to exhibit a blue shift with increasing dielectric constant (ε) of the solvent. From the area under the absorption curve, the natural radiative life-time (τ_{N}) of the fluorescent anion has been calculated. Then this is compared with the values of av. life (τ_{av}), as obtained from phase-shift method, it is observed that while τ_{N} decreases in the order EtOH, n-PrOH, n-BuOH and glycerol, a reverse order of variation is obtained for τ_{av}.

This difference $\Delta\tau = \tau_{N} - \tau_{\mathrm{av}}$ has been explained as due to increasing overlap between absorption and emission spectra caused by stabilisation of ground and excited state energy levels of the absorbing dipole by the solvent orientation polarisation effect on Onsager's reaction field, to difftrent extent in different solvents. Hence $\Delta\tau$ should be proportional to ($\nu_{A} - \nu_{F}$) where ν_{A} and ν_{F} are frequencies of absorption and emission maxima respectively. Following the treatment of Lippert and of Mataga et al, $\Delta\tau$ is plotted against $\left(\frac{D-1}{2D+1} - \frac{n^2-1}{2n^2+1}\right)$. All the points except that for water, fall on a line. From the negative slope it is concluded that fluorescein anion is less polarisable in the excited state than in the ground state.

132. 'The Kinetics of the Reaction between Copper and Iodine Solution in non-aqueous medium'.

P. S. MENE, K. A. VENKATACHALAM and T. DAS, Nagpur.

The reaction between Copper and Iodine solution in non-aqueous medium (Methanol) has been studied and the following points have been observed :—(1) The reaction is of the first order with respect to the Iodine present in the solution, (2) The formation of Cuprous iodide film as a result of the reaction and its unaffecting nature in the rate of reaction, (3) Although a standard rate of 100 r.p.m. for the stirrer is recommended to give reproducible results, consistent results have been obtained with a rate of stirring as high as 200 r.p.m., (4) The nature of the surface of the metal has been found to have little effect on the reaction, (5) The graph of Iodine absorption versus time in non-aqueous (Methanol) medium is found to agree well with those of previous workers, who studied similar systems.

133. Hammett acidity function (H_0) in aqueous acetone.

M. M. MISRA and B. NAYAK, Cuttack.

The Hammett acidity function (H_0) of the solutions of three strong acids, namely, perchloric, hydrochloric, and sulphuric acid, have been measured in acetone-water mixtures, containing 10 and 20 weight % of acetone and perchloric acid alone in acetone-water containing 30 weight % of acetone using p-nitroaniline, and o-nitroaniline as indicators. The concentration range covered for each of these acids is up to 2M. The general validity of H_0 concept in these acetone-water solvents has been established. The effects of the addition of neutral salt on H_0 of 0·25M hydrochloric acid have been examined in solvents containing 10 and 20 weight % acetone. The results appear to be similar to those obtained with aqueous solutions and indicate the specific nature of salt effects.

134. Base Strengths of Nitroanilines in Mixed Solvents : pK's of *Ortho and Meta* Nitroanilinium Ions in Aqueous Acetone.

M. M. MISRA and B. NAYAK, Cuttack.

The pK's of *ortho and para* nitroanilines have been determined in acetone-water mixtures containing varying proportion of acetone up to 30 weight per cent. The pK's were found to decrease with the increase of the acetone content of the medium. This has been explained qualitatively from the stand point of the changes, likely to occur in the activity coefficients of various species in solution with the addition of the organic solvent.

135. Effect of the nature and concentration of the supporting electrolyte on the half-wave potential and diffusion current.

S. N. MUKHERJEE and MRS. ANIMA CHAKRAVARTY, Calcutta.

The diffusion current and half-wave potentials were measured at different concentrations of Ni (ous) and Co (ous) ions in presence of different concentrations of the supporting electrolytes : KCl, KNO_3, NH_4Cl, and $CaCl_2$. Both these parameters exhibit variations which could not be accounted for by changes in viscosity alone. An attempt has been made to explain the observations in the light of the influence of (1) ionic strength, (2) inter ionic forces and (3) the hydrogen overvoltage.

136. The use of oxycellulose-collodion film membrane-electrode for the determination of cationic activity.

H. J. CHAINANI and C. S. NARWANI, Bombay.

A single sheet oxy-cellulose-collodion film of various thickness (0·0205—0·065 cm.), containing 94 m.eq. of $-COOH$ per 100 gm.s. and inactive collodion as a binder, clamped between rubber washers at one end of a glass tube (dia : 1 cm.) could be used as a membrane electrode for determining the activity of a given aqueous solution of an acid or a salt, the saturated calomel electrodes being dipped in the two compartments, the tube and the beaker. Before using, the membrane was soaked for two hours in the solutions of the electrolyte to be studied by introducing 0·0015N solution inside the tube and 0·1N in the beaker. The membrane potential reached equilibrium within five minutes and was constant for more than half an hour. The activity of the cation was calculated by using the equation

$$E = (2t_+ - 1) \frac{RT}{F} \log_e \frac{a_2}{a_1} \quad ;$$

t_+, the transport number inside the membrane was determined from the slope of the st. line graph obtained by plotting E against $\frac{RT}{F} \log_e \frac{a_2}{a_1}$ for different values of $\frac{a_2}{a_1}$. The error in the observed activity was ± 3% in case of salts, and in the pH ± 0·01 in case acids.

137. Polarographic study of metal ion complexes of Keratin fibres (Wool) : Part I, Nitrates and chlorides of Hg++ and Cd.++.

MISS V. T. BALWANI and C. S. NARWANI, Bombay.

Reactions of $Hg(NO_3)_2$, $HgCl_2$, $Cd(NO_3)_2$ and $CdCl_2$ respectively at different concentrations, and room temperature, with (i) pure wool, (ii) Formaldehyde-treated, (iii) Benzoquinone-treated, have been studied by determining Polarographically the concentrations of the (i) Equilibrium solutions, (ii) the HCl extracts and (iii) the NaCl extracts. From the difference in diffusion currents, the gm-atoms of the metal combined with one gram-molecule of wool, have been determined in each case. It has been observed that nitrates of Hg and Cd react with -SH, -COOH and -S-S groups and chlorides of Hg and Cd with -COOH, -S-S and and $-NH_2$ in case of pure wool. It has been presumed that Hg^{++} ions combined with -COOH groups through electrovalent bond, is replaced by Na^+ ions on extraction with NaCl, and that it combined with -S-S- to form -S-Hg-S- and $-NH_2$ to form -NH-HgCl. In case of Formaldehyde-treated wool only -COOH and -S-S- groups and in the Benzoquinone treated only -COOH groups are free for reaction with Hg^{++} and Cd^{++}. It has been also observed that the time for completion in 0·07 M $Hg(NO_3)_2$ and $Cd(NO_3)_2$ in 4 and 4½ hours respectively for one gm. molecule of wool.

Thus the number of -COOH, -S-S- and $-NH_2$ groups in one molecule of wool have been calculated to be 40, 56 and 50 respectively.

138. Polarographic behaviour of Nickel-tetrametaphosphate complexes.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of the complexes formed by nickel with tetrametaphosphate has been investigated. The effect of pH and the influence of competing ligands like OH^-, $CO_3^=$ and NH_3 was also studied. The polarographic waves obtained were irreversible in all cases. pH had little effect on the half-wave potential, indicating that the same species of complexes exists at all pH values. The formula of the complex was determined using the equations developed by Subrahmanya in this laboratory for irreversible systems. It was found that one group of $P_4O_{10}^{4-}$ was attached to each nickel ion. Presence of $CO_3^=$ or OH^- in solution did not alter the nature of the complex species. In ammonia-ammonium chloride solutions evidence for the formation of $[Ni(P_4O_{12})(NH_3)_2]^{2-}$ was obtained.

139. Polarographic behaviour of tetrametaphosphate complexes of lead.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

Sodium tetrametaphosphate is the second member of the homologous ring phosphate system and in common with them, tetrametaphosphate exhibits the property of sequestering metal ions in solutions. The nature of the complexes formed by the common metal ions with tetrametaphosphate has been investigated and in the present paper, the results obtained in the case of lead have been presented, using the polarographic method of investigation of metallic complexes.

Single reversible polarographic waves have been observed in the case of lead. One $P_4O_{12}^{4-}$ is found to be attached to each metal ion at all pH values below 11. Above pH 11, only biplumbite ion exists in solution. The effect of competing ligands like $CO_3^=$ and NH_3 was investigated and evidence for the formation of the following mixed complexes was obtained

$$[Pb(P_4O_{12})(NH_3)_2]^{2-} \text{ and } [Pb(P_4O_{12})(CO_3)]^{4-}$$

140. Absorption Spectra of the Oximes of Cyanacetic Acid derivatives.

A. M. TALATI and T. I. PATEL, Baroda.

Alpha-isonitroso cyanacetic acid derivatives have been prepared and their ultraviolet absorption spectra in water and methanol are obtained using Beckmann DU spectrophotometer. The spectra of these oximes are compared with those of the monoximes and the dioximes derived from acetoacetanilide (Dave and Talati, J. Chem. Soc., 1960, 900) and the effects of the different groups and the solvents on the absorption bands are considered.

141. Studies on the Double Layer of Titanium Dioxide Suspensions.

BHAGWAN SWAROOP SRIVASTAVA, Lucknow.

An attempt was made to prepare sols with the same characteristics in order to avoid the complexities present in the system due to uncertainty of the number of water molecules associated with titanium dioxide. The changes occurring in the double layer of these suspensions were followed as a function of concentration of various surfactants, using potentiometric method.

142. Cohesive-energy-densities of High Polymers.

S. PATRA, S. B. RATH and D. MANGARAJ, Cuttack.

A knowledge of intermolecular forces in high polymers is essential to correlate their bulk properties with the chemical structure of the repeating unit. Cohesive-energy-density is used as a measure of intermolecular forces. However, methods used for estimating this quantity for simple liquids and solids, cannot be applied to polymers. Indirect methods like swelling and solution viscosity measurements and initial-phase-separation titration have been used in past to estimate cohesive energies density of polymers. In most cases the success is limited because measurements have been done in polar systems, where the basic Scatchard-Hildebrand relation for heat of mixing does not apply. In the present work, attempt has been made to confine these measurements in solvents which are structurally alike among themselves and with the repeating unit of the polymer. Thus a series of alkyl esters have been used in case of ester polymers and hydrocarbons in case of Natural Rubber. Swelling measurements have been done with two polymers, polyvinyl acetate and polyethoxyethyl-methacrylate. Solution viscosity measurements, using a modified Ubeholde type viscometer, have been carried out with 4 polymers, namely polyvinyl acetate, polyethylacrylate, polymethylacrylate and natural rubber. Initialphase-separation titrations have been done with latter polymers. Except the linear polyvinyl acetate and natural rubber, all other polymers were synthesised in the laboratory. A number of solvents were also synthesised. The cohesive-energy density values obtained by different measurements agreed within experimental error among themselves and with the existing literature data. The mean values of cohesive energy densities for polyvinyl-acetate, polymethyl acrylate, polyethylacrylate, polyethoxy-ethyl-methacrylate and natural rubber are 87·4, 101·1, 88·3, 65·6 cal/cc respectively. In conclusion it may be said that choice of solvents is essential for precise measurements of cohesive energy density in high polymers, using any of the methods mentioned above.

143. Studies on Metal Thiourea Complexes.

C. E. S. VAZ and S. N. BANERJEE, Kharagpur.

Different types of thiourea complexes with mercuric chloride have been reported by different workers. In the present investigation by Job's method of continuous variation using molar conductivity as an indicative property it has been possible to obtain only three sharp peaks at concentration of $HgCl_2$: Thiourea corresponding to 1 :1, 1 :2 and 1 :4 ratios. It has not been possible, by this method, to detect complexes with 1 :0·5, 1 :1·5 and 1 :3 ratios reported in the literature. Thermometric and conductometric titrations have also been attempted by adding thiourea to mercuric chloride solutions at different concentrations with no useful results, as the reaction rate between $HgCl_2$ and thiourea was found to be too slow. Investigations to study complex formation between thiourea and various substituted thioureas with different metal salts, to study the effect of the substituents on the stability of the complexes and to elucidate the structure of these complexes are in progress.

144. Amphoterism of Hydrous Thorium Oxide and the adsorption of Fuchsine by the Hydrous Oxide.

RAMESHWAR PRASAD and ARUN K. DEY, Allahabad.

Four samples A, B, C and D of hydrous thorium oxide were prepared by the interaction of solutions of thorium chloride with 10% deficient, equivalent, 5% excess and 10% excess of alkali respectively. It has been observed that the adsorption diminishes with rise in temperature in all the samples. The results have been found to support the amphoterism of hydrous thorium oxide and to suggest that the hydrous oxide behaves as isoelectric in sample C.

145. Behaviour of p-Nitrobenzene Azochromotropic Acid (Chromotrope 2B) as a Colloidal Electrolyte.

SURESH C. SRIVASTAVA, ROSHAN LAL SETH and ARUN K. DEY, Allahabad.

Measurements of electrical conductance were performed with aqueous solutions of p-nitrobenzene azochromotropic acid (Cromotrope 2B), which has been observed to behave as a colloidal electrolyte. The compound, well known for its chromophoric properties, does not obey Beer's law in concentrated solutions, and the square root of concentration *versus* equivalent conductance curve is not linear but is similar to the curves of colloidal electrolytes.

The temperature of zero conductance, extrapolated from measurements of conductance at five different temperatures, comes out to be −16·5°C. The temperature coefficient per degree centigrade per 100 of the conductance at 35°C, has been observed to be below 2·0.

146. 7-Iodo 8-Hydroxy Quinoline 5-Sulphonic Acid (Ferron) as a Colloidal Electrolyte.

SURESH C. SRIVASTAVA, ROSHAN LAL SETH and ARUN K. DEY, Allahabad.

Electrical conductance studies have been performed to investigate the nature of aqueous solutions of 7-iodo 8-hydroxy quinoline 5-sulphonic acid (Ferron). The reagent has been found to behave as a colloidal electrolyte and does not obey Beer's law in concentrated solutions. The curve between the square root of concentration and equivalent conductance is not linear and resembles those of colloidal electrolytes. The temperature of zero conductance has also been determined to be −32°C. The temperature coefficient per degree centigrade per 100 of the conductance at 35°C ranges between 1·56 and 1·72.

147. Study on the Citrate Complex of Strontium.

RABINDRA K. PATTNAIK and S. PANI, Sambalpur.

The Citrate complex of Strontium has been investigated by the pH titration method at the pH 7·2 to 7·3.

The equilibrium constant of the reaction $Sr^{++} + Cit^{3-} \rightleftharpoons SrCit^{-}$ is determined to be $5{\cdot}23 \times 10^2$.

148. Study on the Citrate Complex of Magnesium.

RABINDRA K. PATTNAIK and S. PANI, Sambalpur.

The Citrate complex of Magnesium is studied by the pH titration method at pH 6·9 to 7·1. There is no liberation of proton due to complex formation. The equilibrium constant of the reaction $Mg^{++} + Cit^{3-} \rightleftharpoons MgCit^{-}$ is found to be $5{\cdot}89 \times 10^3$.

149. Polarography of Cerium in Lithium Sulphate.

O. P. AGRAWAL and R. C. KAPOOR, Allahabad.

Polarographic behaviour of ammonium hexanitratocerate and double sulphate of cerium (ceric ammonium sulphate), was studied using 0·1 M lithium sulphate as supporting electrolyte. Two waves were observed, one present at zero applied e.m.f. and second starting at −1·4 vols. The first wave is observed at concentrations above 2×10^{-4} M and represents the reduction of ceric into cerous stage. Ammonium hexanitratocerate gives second wave, only at very low concentrations. At concentrations higher than 2×10^{-4} M it is overlapped by hydrogen evolution. In case of ceric ammonium sulphate the second wave is visible even at higher concentrations, and thus both the waves are visible at concentration 3×10^{-4} M and above. The limiting current of the second wave is twelve to fourteen times of that of the first wave and $E_1/_2$ value is −1·575 ± 0·005 volt for ceric ammonium sulphate and −1·574 ± 0·01 volt for ammonium hexanitratocerate. The irreversible second wave is proposed to be a catalytic hydrogen wave.

150. The Polarographic Behaviour of Thioacetamide.

T. D. SETH and R. C. KAPOOR, Allahabad.

The polarographic behaviour of thioacetamide was studied in phosphate buffer and potassium nitrate solution. The pH was maintained at 6·8 where the stability of thioacetamide is maximum. Current-voltage curves were taken at different concentrations of thioacetamide.

Thioacetamide gives a well-defined anodic wave which is preceded by a prewave. The anodic wave is probably due to the formation of a compound between thioacetamide and mercury. The pre-wave appears to be an adsorption wave.

151. Estimation of Acetone-Ethanol and n-Butanol.

S. C. MEHTA and P. S. MENE, Nagpur.

Various methods have been reviewed for the estimation of Acetone-Ethanol and n-Butanol in the ternary mixture. It is found that if one of the components is estimated by chemical method, the composition of the ternary mixture can be obtained by use of the one of the physical properties like viscosity, solubility. Other physical properties like refractive index, density and surface tension are not of any help, since these properties are almost identical or the range is so small that the accuracy in estimation is limited. Bogin has taken the advantage of relative solubility of these constituents in water. Bogin's method is suitable for solutions containing 20 o 36 per cent of acetone and at least 50 per cent of n-Butanol. Mixtures of such compositions will give sharp end point when titrated against distilled water. For low concentration of acetone from 0 to 25 per cent viscosity can be used as one of the parameters for estimating the ternary mixtures accurately and rapidly. The same method can be extended to mixtures containing homologous components whether other physical properties are almost identical and where the presence of other component may interfere by chemical estimation. For other concentrations the mixture may be diluted by adding n-Butanol to bring down the composition of the mixture within this working limit.

152. Conductometric Titration of Nitrite with HCl.

B. P. GYANI, Patna and R. K. PRASAD, Muzaffarpur.

When sodium nitrite (cell) is titrated conductometrically with HCl at room temperature (28°C) the acid required is 25-30% less than the theoretical value for the reaction $NaNO_2 + H^+ \rightleftharpoons HNO_2 + Na^+$. The discrepancy is only 20% at 0°C. This may be due to decomposition of the nitrous acid liberated at first, $3HNO_2 = HNO_3 + 2NO + H_2O$. The gaseous product so obtained increases the resistance of the solution. The reverse titration is also anomalous.

153. Oxidation of Mandelic Acid by Acid Dichromate in presence of Manganous Sulphate.

B. P. GYANI, Ranchi and SUKHNANDAN PRASAD, Muzaffarpur.

The oxidation of mandelic acid by dichromate is slow at room temperature but when manganous sulphate is added it is quite rapid. Depending upon the quantities of sulphuric acid and manganous sulphate added, mandelic acid may be quantitatively oxidized either to benzoyl formic acid or benzoic acid, or a mixture of the two.

154. Potentrometric Titration of Sodium Nitrite with HCl in presence of Urea and KI.

B. P. GYANI, Ranchi and R. K. PRASAD, Muzaffarpur.

Since the nitrite ions and nitrous acid are both liable to oxidation in solution the mineral acid requirement for liberating nitrous acid from sodium nitrite is usually less than the theoretical value. When urea or KI are present, the acid requirement improves. The improvement is less in the case of urea. Values approaching the theoretical are obtained in the case of KI. These results may be ascribed to a slow reaction of the liberated HNO_2 with urea and a much faster one with KI. Nitrite may thus be determined with an accuracy of 1·2% even in molar solutions and at room temperature.

155. Physico-chemical studies on the decomposition of Blue Peroxy Chromic Acid —Part I : Conductometric study on the decomposition of Ethereal Blue Peroxychromic Acid in aqueous medium.

C. V. P. PILLAI and M. C. SAXENA, Saugar

Decomposition of the so-called blue peroxy chromic acid has been studied conductometrically in aqueous medium at 20°C, 25°C and 35°C. The ratio between ethereal peroxychromic acid solution and water was 1 :1 in each case. The observations at 25°C were repeated by varying the amount of ethereal peroxychromic acid and water in the ratios 1 :2, 1 :3 and 1 :4.

The graphic representation between the observed conductivity and time in each case suggested that the decomposition occurred in three definite stages. This has been explained by assuming the formula of the blue peroxychromic acid to be $Cr_2(Cr_2O_{10})_3$. The decomposition can be represented as :

$Cr_2(Cr_2O_{10})_3 \rightarrow Cr_2(Cr_2O_9)_3 + 3O$ . . . . . . 1st stage

$Cr_2(Cr_2O_9)_3 \rightarrow Cr_2(Cr_2O_8)_3 + 3O$ . . . . . . 2nd stage

and $Cr_2(Cr_2O_8)_3 \rightarrow Cr_2(Cr_2O_7)_3 + 3O$ . . . . . . 3rd stage

The final decomposition product being chromium-di-chromate $Cr_2(Cr_2O_7)_3$.

156. Thermodynamics and Solid-state Chemistry of Addition Compounds.

R. P. RASTOGI, R. K. NIGAM, PARMJIT S. BASSI, RAJINDER NATH SHARMA
and SATISH KUMAR SHARMA, Chandigarh.

The thermodynamics and the solid state chemistry of 1 : 1 benzophenone-diphenylamine complex has been studied. A thermistor calorimeter has been described for the accurate measurement of heat of fusion. The heat of fusion and the entropy of fusion of the compound have been found to be 7710±50 cal/mole and 24·6 ± ·2 cal./deg./mole respectively. The entropy of fusion of diphenylamine and benzophenone are found to be 13·7±·2 and 12·6±·2 cal./deg./gm. mole respectively. This is discussed from statistical mechanical considerations.

The addition reaction between benzophenone and diphenylamine is found to occur in the solid state. A technique for measuring the reaction temperature is described. The reaction temperature is found to be 3·4°C. The progress of reaction in the solid-state has been investigated at 10°C, which is found to be very slow. A study of micro-structures with the help of photo-micrography has also been made. The reactants are capable of diffusing through product layer but it is a very slow process.

With a view to elucidate the role of nuclei-formation and growth, experiments for the study of rate of nuclei-formation in melts of the addition compound and the linear rate of advance of solid-liquid interface were also performed.

157. Charge and Stability of Colloids. Part XXVIII. Effect of temperature on coagulation constants of Ferric hydroxide sol.

B. P. YADAVA and RUPENDRA KUMAR VERMA, Lucknow.

A. Bhattacharya and A. K. Bhattacharya* have verified the validity of the equation $\frac{1}{c-a} = \frac{n}{m}t + \frac{1}{m}$ by calculating the values of the constants a, m and n, employing the data available in the literature. We have expreimentally determined the variation in viscosity with time while coagulating the dialysed sol of ferric hyydroxide at different temperatures. It has been found that the values of critical stability concentration 'a' decreases regularly in a linear manner with the rise of temperature. The values of the constants 'm' and 'n' also decrease with the rise of temperature. The decrease in the values of 'a' indicates that maximum concentration of coagulating ions of the electrolyte, which causes no coagulation, falls with the rise of temperature. It means that the sol loses its stability as the temperature increases. Freundlich† observed that the excess of kinetic energy above the critical value, which is responsible for coagulation of the sol, increases with the increase of coagulating ion concentration. We observed that the maximum stability concentration is directly related to the temperature and kinetic energy of the coagulating particles. The decrease in the value of 'm' with the rise in temperature indicates that less concentration of coagulating ion above the critical stability concentration is required to cause coagulation, while the decrease in the value of 'n' shows that greater degree of aggregation takes place at higher temperatures.

158. Anion Electrodes—Part I—Mercury-mercurous arsenate electrode.

G. CHOUDHARY, S. N. DAS and S. SWAROOPA, Patna.

A new anion electrode has been set up constituting of mercury in conjunction with mercury arsenate (ous). The e.m.f. measurement are quite promising and are impregnated with interesting idea regarding structure of mercurous arsenate. Work under more stringent conditions yielding results of high accuracy is in progress.

159. A study of the Electrolytic preparation of Bromates using Graphite and/or Carbon Substrate Lead Dioxide Anodes.

H. V. K. UDUPA, Karaikudi.

Lead dioxide deposited on graphite or carbon substrate has been used as anodes in the electrolytic preparation of bromates from bromide.

The influence of anodic current density, temperature, and addition agents on the current efficiency of bromate formation has been studied. Use of lead dioxide anodes permits the use of high anode current density (10 to 40 amp/dm^2), employing high electrolyte temperature (upto 60°C) under which conditions mere graphite or carbon as anode would disintegrate considerably.

Current efficiency of 93 to 96% has been obtained for bromate formation. The isolation of the product is described and the purity of the same reported. Energy consumption (d.c.) for potassium bromate and sodium bromate are 3·87· kwh/kg and 4·32 kwh/kg respectively.

A cell in which nearly 0·5 kg of potassium bromate could be produced by electrolysing for 8 hours is described.

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* A. Bhattacharya and A. K. Bhattacharya; J. Colloidal Science, **11**, 124 (1956).

† Kolloid Z. Vol. 23, 163 (1918).

160. Studies on the Kinetics of Oxidation of Mercurous Ion by Persulphate Ion—Part I.

J. C. GUPTA and S. P. SRIVASTAVA, Naini Tal.

The kinetics of the hitherto unstudied oxidation of mercurous nitrate by potassium persulphate, both uncatalysed and silver ion catalysed has been investigated. The results are found to be reproducible when the necessary precautions about the extreme purity of the materials and the medium are taken. It is found that the uncatalysed reaction is of a measurable velocity at 40°C at rather high concentrations of the reactants The reaction is found to be slightly influenced by light, being slightly slower in the dark.

The order of the recation with respect to mercurous ion for the silver catalysed reaction is found to be 0·5, while the order with respect to persulphate ion is found to be approximately one. However, the reaction is found to be attended with an induction period at higher concentrations of mercurous nitrate and the extent of this induction period increases with an increase in mercurous ion concentration. The rate of the reaction is found to increase with an increase in silver nitrate concentration.

161. Electron Diffraction Studies of Chemical Reactions on Single Crystal Surfaces of Zinc.

H. K. ACHARYA, Poona.

The single crystals of zinc have been prepared by slow cooking of the molten metal and the crystallographic orientation, degree of roughness, crystal perfection of the cleavage face and (001) face of the (1012) twin of zinc and the chemical reactions by (i) thermal oxidation in air, (ii) by treatment with H_2S gas or with benzene followed by oxidation in air have been followed by electron diffraction method.

The reaction products in each case have been identified and their orientations with respect to the substrate have been determined.

The important result has been established that even when examined in vacuo within five minutes after cleavage, these surfaces which are relatively perfect since they yielded clear Kikuchi bands were invariably covered with an extremely thin optically invisible layer of highly (001) oriented zinc oxide crystals having an exceedingly smooth surface parallel to the substrate. The hitherto unnoticed fact, that while the Kikuchi bands correspond to the metallic zinc, the strongly elongated spots in the same pattern are due to a zinc oxide lattice has also been established.

When heated in air at 200° for 12 hours the Z_nO spot pattern on the cleavage plane becomes sharp and also less elongated, but otherwise remains unchanged in orientation and thin over much of the surface. This result indicates the protective action of the oriented Z_nO film.

The oxide layer of zinc cleavage planes remains unchanged even after two hours heating in air at 400°C and only after long further heating at this temperature did the Z_nO ring pattern appear. The Z_nO spot patterns are, however, still present.

A cleavage face of zinc which had been treated with crystallisable benzene gave on subsequent heating in air at 400°C for fifteen minutes an arced ring pattern of zinc oxide showing two degree (101) and (001) orientations. Another cleavage face which was exposed to dilute hydrogen sulphide gas in air gave on subsequent heating in air at 400°C for a short time an oxide pattern with (101) and (001) orientations closely similar to those obtained from the cleavage face treated with benzene.

The (001) plance of the (1012) twin perpendicular to the cleavage plane gives Kikuchi bands and zinc oxide spot pattern exactly similar to that from the cleavage planes, but this plane also gave very sharp and round spot due to zinc and those relatively rough parts of the surfaces. On heating in air at 400°C for fifteen minutes the (001) face of (1012) twin gave an arced ring pattern due to (001) orientation, but after one hour heating at the same temperature only ring pattern without any orientation remained. This result is attributed to the roughness of much of the (001) face of (1012) twin with respect to (001) cleavage plane of zinc crystal.

162. Thermodynamic Interaction Parameters of Polystyrene in p-Xylene.

D. D. KHANOLKAR and T. S. MURLIDHARAN, Poona.

Intrinsic viscosities of four different high molecular weight fractions of polystyrene in p-zylene at 30°, 34° and 40°C were determined from solution viscosities measured in a precision bore capillary viscometer of Ostwald type. These data were employed to calculate Flory temperature θ, entropy of dilution Ψ_1, and heat of dilution k_1 with the help of equations given by Flory and coworkers for the evaluation of these parameters. The values of these parameters, namely $\theta = 177°K$, $\Psi_1 = 0{\cdot}11$ and $k_1 = 0{\cdot}065$ are in good agreement with those reported by Flory et al. for polystyrene in benzene and toluene.

163. Electron Diffraction Studies of Chemical Reactions on Single Crystal Surface of Bismuth.

H. K. ACHARYA, Poona.

The single crystals of bismuth were prepared by two different methods: (i) by casting the molten metal on glass or mica surfaces followed by slow cooling, and (ii) by a modified Bridgman method.

The cast surfaces of bismuth single crystals prepared by method (i), gave clear Kikuchi bands corresponding to the pseudocubic (100) face parallel to or within 20° to the substrate. The cleavage faces obtained from bismuth single crystals prepared by method (ii), gave Kikuchi bands corresponding to (111) plane, but did not show spot pattern due to an oxide layer.

When heated in air at 250°C for one hour the (100) face gave a random oxide pattern corresponding to Bi_2O_3 having a face centred cubic structure with a=5·40A. The cleavage faces (111) heated at the same temperature for the same length of time gave only diffuse hallows which became clear rings only after four hours' heating at the same temperature.

When exposed to dry iodine vapour the (100) face gave a random ring pattern due to B_iI_3 while the cleavage plane (111) being similarly treated gave a pattern showing 2° (111) orientation of B_iI_3.

When exposed to moist iodine vapour or iodine vapour from its solution in benzene, alcohol or acetone or even when dipped in a solution of iodine in benzene, the (100) face of bismuth gave ring patterns due to B_1I_3. The (100) face exposed to moist chlorine gas or bromine vapour or even when etched with 1:1 hydrochloric acid or saturated bromine water, gave ring patterns due to oxy-chloride or oxy-bromide in respective cases.

164. Thermal Oxidation of Antimony Single Crystals.

H. K. ACHARYA, Poona.

The thermal oxidation of the cleavage plane of antimony single crystals has been followed by electron diffraction method. The results show that the antimony cleavage (111) planes which are atomically smooth, give clear Kikuchi bands, but do not show a pattern due to oxide layer which, even if present at all, must have been less than 10A thick. On being heated in air at 400°C for a short time the cleavage face gave an arced ring pattern showing two-degree (111) orientation of the Sb_2O_3. The ring pattern of Sb_2O_3 corresponds to a cubic structure with $a=11{\cdot}20$A agreeing with X-ray data.

165. Transference Number of Ortho Phosphoric Acid.

J. N. SAHAY, Ranchi.

The present work arose out of certain observations by Kerker and Espenscheid (*J. Amer. Chem. Soc.* 1958, *80*, 776) that they attempted to get independent data for the transference number of phosphoric acid by the Hittorf method but were unsuccessful in preparing nongassing electrodes. During the present investigations transference number of aqueous solutions of orthophosphoric acid over the range of molar concentration employed by Kerker and Espenscheid have been obtained by this method using amalgamated zinc rod as anode. Mercury contained in a specially designed trumpet-shaped tube covered with concentrated solution of zinc chloride and on the top of this, solution of orthophosphoric acid avoiding mixing served as cathode. This arrangement prevented the evolution of hydrogen and production of OH. The result show high value for the transference number of $H+$ and low for H_2PO_4- which could be explained if we account for the transference of additional phosphoric acid to the cathode with the possibility of ionic species H_4PO_4+.

166. Studies on the coagulation of Colloids with special reference to the variation of time of coagulation with concentration of electrolytes as applied to Zinc-ferrocyanide sol.

S. L. GUPTA, Pilani.

This piece of work relates the slow coagulation of Zinc-ferrocyanide sol by various uni-bi-ter and tetra-valent precipitating ions. The results obtained with various electrolytes are interesting enough to provoke thought on the aspect of slow coagulation in the light of the empirical equation;

$$C=a+\frac{m.\ 1/t}{n+1/t}$$

suggested by Bhattacharya and Co-workers, where 'C' is the precipitation—concentration of the electrolyte; 't' is the time of coagulation and 'a', 'm' and 'n' are constants which depend on such factors as are connected with its stability and coagulation. This equation represents a rectangular hyperbola and it is interesting to find that the graphs of C against $\frac{1}{t}$ drawn from experimental results are indeed of hyperbolic nature. A method for the evaluation of the values of the constants is also given.

167. Mixed Mesomorphism—II.

J. S. DAVE and J. M. LOHAR, Baroda.

Continuing our work further (Proc. Nat. Acad. Sci. India, *29A*, Part I, pp. 35-38, 1960, ibid., *29A*, Part III, 1960) we have examined binary systems in which both the components are liquid crystals. Although continuous series of mixed liquid crystals are formed over the entire range of concentration, it is observed that there takes place a depression in the transition line when the admixed molecules depart from the criterion of similarity; this can be attributed to the difficulty in packing of the molecules. Slope of the transition line can be measured from either side and the group slope values could be deduced therefrom. These values are found to be comparable with those obtained from the study of the binary mixtures where one component is a non-liquid crystal. This suggests that the specific effect of the terminal groups is operative even in the case of liquid crystalline substances.

168. Effect of a.c. ripple on the behaviour of Bromothymol Blue at the dropping Mercury Electrode.

S. L. GUPTA and L. SARASWATHI, Pilani.

This piece of work relates to the effect of 50 cycle a.c. ripple of varying magnitudes i.e. from 10 mv. to 150 mv. (r.m.s.) on the behaviour of bromothymol blue at the dropping mercury electrode. Bromothymol blue affects the differential capacity of the dropping mercury electrode in two ways. Firstly at about the electro-capillary zero there is a strong lowering of the capacity due to adsorption of B.T.B. Secondly, at a higher cathodic potential, there is a sharp increase in the differential capacity leading to a maximum followed by a sharp fall in the capacity.

It is seen in general that the lowering of the capacity as well as the magnitude of the maximum diminish with increase in a.c. ripple. There is practically no shift in the peak potential with increase in a.c. ripple. The diminution in the magnitude of the maximum with increase in a.c. ripple is in accordance with the theory of maximum based on adsorption and desorption phenomena at the dropping mercury electrode.

169. Complex forming property of Graham Salt : Part IV—System $CaCl_2$-H_2O-$(NaPO_3)_n$

A. C. CHATTERJI and R. M. BHATNAGAR, Lucknow.

Binding of calcium ion by Graham salt has been studied in detail. pH titrations, conductometric titrations, Job's method of continued variation and solubility method were used in the investigation. The titrations were carried out with various samples of Graham salt having different weight average molecular weights ranging from 6,000 to 16,000. Following results were obtained :

Method	Ratio (Ca^{++} : PO_3^-)
1. pH titrations	1 : 2 (Pption) 1 : 3 (Dissolution)
2. Conductometric titrations ...	1 : 2 ,, 1 : 3 ,, and 1 : 4
3. Job's method (Conductivity)	a peak at 1 : 2

The precipitate obtained at the ratio 1 : 2 which contained no sodium and appeared to be pure calcium polymeta-phosphate on analysis was used. Its solubility in a known amount of Graham salt was determined. By this method, values of log K at two different temperatures were determined; the other calculated thermodynamic constants from log K values are given below for 1 : 3 complex using standard equations.

Temp.	p (coord. no.)	log K	Δ F	Δ H	Δ S
35°C	1	7·92	−11·09 K. cal.	−13·59 K. cal.	−8 cal.
45°C	1	7·62			

170. Effect of Acids on the rate of reaction between Formic Acid and Chromic Acid. Part—III.

A. V. MAHAJANI, Sagar.

A kinetic study of the effect of phosphoric acid on the rate of reaction between formic acid and chromic acid has been made. In this reaction the order with respect to chromic acid is one. The presence of phosphoric acid, at the experimental concentration range of 0·08 to 3·20 N, in the reaction mixture is found to have no effect on the order of the reaction. The velocity coefficient is however, found to increase with the increasing concentration of phosphoric acid. As phosphoric acid does not react with either of the reactants, it is a positive catalyst in this reaction. The temperature coefficient of the reaction is not changed by its presence in the reaction mixture.

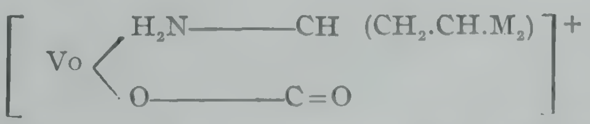
As phosphoric acid does not alter the order and the temperature coefficient of the reaction between formic acid, and chromic acid, it appears that the intermediate steps of the reaction are essentially the same in the presence of the added acid as in its absence.

171. Spectrophotometric and Conductometric Study of the reaction between Vanadyl Sulphate and Leucine.

P. K. BHATTACHARYA, Saugor.

Th amino acids are known to form complexes with number of metal ions. The present work reports the results of the interaction between leucine and vanadyl sulphate.

The system under investigation has been studied by using Job's continuous variation methods in conductometric and spectrophotometric measurements. The method has been worked out for three different sets of equimolar solutions of vanadyl sulphate and leucine namely, M/30, M/40 and M/60 in conductometric measurements and for M/10 solutions in spectrophotometric measurements at wavelengths 750 mμ, 800mμ and 850 mμ. The results of the aforesaid investigation are unequivocal suggesting the formation of 1 : 1 complex, which may be represented by the formula



$$\left[\mathrm{Vo} \begin{matrix} \diagup \mathrm{H_2N}\text{———}\mathrm{CH}\ \ (\mathrm{CH_2.CH.M_2}) \\ \diagdown \mathrm{O}\text{———}\mathrm{C{=}O} \end{matrix} \right]^+$$

The dissociation constant, K for vanadyl complex has been determined, its average value being $15{\cdot}37\times10^{-4}$ at 28°C.

172. Studies on Coordination Compounds of Uranyl Acetate with Organic Acids—Part I. The System :—Uranyl acetate-mandelic acid-water.

C. S. PANDE and S. K. MISRA, Lucknow.

Physico-chemical studies of the solutions of uranyl acetate and mandelic acid were carried out by following Monovariation Method of Nayar and Pandey (Proc. Ind. Acad. Sci., *27-A*, 286, 1948). The properties studied were conductivity and pH. Further, conductometric and electrometric titrations were also carried out for (1 : 1) and (1 : 2) molecular ratios of uranyl acetate and mandelic acid and the curves examined.

After ascertaining the evidence of the formation of complexes at the molecular ratios of (1 : 1) and (1 : 2) of uranyl acetate and mandelic acid, attempts were made to isolate these compounds in solid state by evaporating the solutions in the stoichiometric ratios of 1 : 1) and (1 : 2). The crystals formed were separated and the compounds analysed for the contents of uranium and mandelic acid. The compounds prepared have been assigned the formulae :—

1. UO_2 $(C_8H_6O_3)$ $2H_2O$ and
2. UO_2 $(C_8H_6O_3)_2$.

173. Studies on Coordination Compounds of Uranyl Acetate with Organic Acids—Part II. The System :—Uranyl acetate-lactic acid-water.

C. S. PANDE and S. K. MISRA, Lucknow.

Conductometric, colorimetric and pH studies of this system revealed the evidence of the formation of two complex compounds at the molecular ratios of (1 : 1) and (1 : 2) of uranyl acetate and lactic acid. The method employed was Nayar and Pande's Monovariation Method.

These compounds have been isolated in the pure solid state by evaporation. The uranium and lactic acid contents were then estimated for both of them to assign them possible formulae : The formulae assigned to them are as follows :—

(1) UO_2 $(C_3H_5O_3)$ $2H_2O$ and
(2) UO_2 $(C_3H_4O_3)_2$.

174. Studies on Coordination Compounds of Uranyl Acetate with some Organic Substances. The System :—Uranyl acetate-pyrocatechol-water.

C. S. PANDE and S. K. MISRA, Lucknow.

The results of such physico-chemical properties as conductivity, colorimetry and pH revealed the evidence of the formation of two complex compounds in solution at molar ratios of (1 : 1) and (1 : 2) of uranyl acetate and pyrocatechol. Further, conductometric and pH titrations were also carried out which also gave the same evidence.

Attempts were made to isolate these compounds in solution. (1 : 1) compound was prepared by evaporating the solution of uranyl acetate and pyrocatechol in the stoichiometry of (1 :1) in aqueous phase. However, all attempts to prepare (1 : 2) compound failed. The uranium and pyrocatechol content of the (1 : 1) compound was determined which corresponded with the formula :

UO_2 $(C_6H_4O_2)$.

175. Polarographic Behaviour of Metal-Amino Acid Complexes. Part I—Cadmium.

G. NAGESWARA RAO and R. S. SUBRAHMANYA, Bangalore.

Amino acids form strong chelates with several metal ions. The metal chelates formed are of great biochemical interest, since proteins are made up of essentially simple amino acid molecules. The polarographic method is ideally suited for the investigation of such complexes. In this paper are reported the results of the study of polarographic behaviour of cadmium in presence of aspartic acid, asparigine and valine. The ionic strength of the solution was kept at unity using potassium nitrate. 0·001% gelatin has been included to suppress the polarographic maximum. Cadmium gives a single reversible wave with all the three complexing agents. The shift in the half-wave potential with an increase in pH of the solution, and also the concentration of complexing agents, indicates that two amino acid molecules are chelated with the metal ion in case of aspartic acid, and three molecules in case of valine and asparigine. The dissociation constants of the complexes formed have been calculated using Lingane's equation.

176. Polarographic Behaviour of Metal-Amino Acid Complexes. Part II—Lead.

G. NAGESWARA RAO and R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of lead in presence of alanine, aspartic acid and asparigine as complexing agents has been investigated at various pH values employing potassium nitrate as indifferent electrolyte. 0·001% gelatin is added to suppress the polarographic maximum. These amino acids are capable of forming chelates with metals. In presence of all the three amino acids lead gives reversible polarographic wave. The shift in the half-wave potential with an increase in the concentration of the complexing agent and pH indicates chelate formation in which two molecules of the amino acid take part in case of asparigine and one molecule in case of alanine and aspartic acid. The dissociation constant was calculated by employing Lingane's equation.

177. Paper Chromatographic Studies on Liesegang Ring Formation.

SAMIR KUMAR MUKHERJEE, Roorkee.

An investigation of the nature of the rhythmic patterns obtained by diffusing the reactant solution on the circular filter papers impregnated with the precipitating agents and a protective colloid (2% agar agar) has been made. The systems: $AgNO_3$-K_7CrO_4, $Pb(NO_3)_2$-K_2CrO_4, $Ba(NO_3)_2$-K_2CrO_4, $Co(NO_3)_2$-$K_4Fe(CN)_6$ and $Co(NO_3)_2$-$K_3\,Fe(CN)_6$ were studied. The following important observations were noted :

(1) Radial rhythmicity in all the cases when potassium chromate was used as precipitating agent; (2) The clear radial gaps are more marked in the case of $Pb(NO_3)_2$-K_2CrO_4 and $Ba(NO_3)_2$-K_2CrO_4; (3) The radial gaps are closer as the concentration of Pb++ solution is increased; (4) In between the gaps or spaces beautiful rhythmic patterns were obtained, specially in the case of $AgNO_3$-K_2CrO_4 the patterns are more marked; (5) Ring rhythmicity with $Co(NO_3)_2$-$K_4Fe(CN)_6$; (6) Rhythmic patterns (radial type, but not so clear gaps) with cobalt-ferricyanide.

An attempt has been made to explain the causes of radial and ring rhythmicity on filter papers on the basis of coagulation theory of Dhar and Chatterji.

178. Liquid—liquid Equilibrium Studies.

K. N. ROY and B. N. GHOSH, Bombay.

Liquid-liquid equilibrium data are of importance both from the fundamental aspect of Phase-rule study and also in industry. Phase eqilibrium data for a few ternary liquid-liquid systems have been obtained. The tie-line data for the different systems have been correlated by the methods of Hand and Othmer-Tobias; the corresponding equations have been deduced and their limitations discussed.

179. Electromigration and Diffusion of Na+ Ions in Fused Alkali Nitrates.

H. J. ARNIKAR and D. K. SHARMA Varanasi.

Employing the tracer technique developed earlier in these laboratories, the electromigration and diffusion of Na+ ions, labelled with Na-22, were studied in fused sodium and potassium nitrates as well as in a 45·5+54·5% eutectic mixture of the two. The studies were effected under conditions of both (1) constant 'T' of 350°C and (2) constant reduced temperature 'Θ' of 1·2 (temp. used/M.P. of the medium). Data for the diffusion coefficient 'D' and relative ionic mobility 'v' are presented for the three media for constant T and Θ. It is significant that both v and D vary in the order for the media.

$$NaNO_3 > \text{eutectic} > KNO_3$$

The contrary influence of rise of T and of Θ are discussed in the case of the eutectic medium in particular. To interpret the marked assymmetry in the Gaussian distribution following electromigration, observed also in other fused, aqueous and gel media, a correction ± has been suggested to D in the expression.

$$a\,(x, t) = \frac{a_0}{\sqrt{4\pi Dt}}\, e^{-x^2/4Dt}$$

Examination of the v and D values further indicate a marked deviation from the simple Einstein-Nernst relation. The deviation factor f in the relation.

$$v/D = f \; \frac{(Ze)}{kT}$$

is of the order of 2 for the KNO_3 and 2·5 for the $NaNO_3$ and the eutectic. The significance of this deviation is discussed.

180. Electrolysis of Ammonium Sulphate solution.

B. P.GYANI, Ranchi and (Miss) RANI MISRA, Patna.

The current-time graphs of electrolysis of undisturbed solutions of ammonium sulphate are similar to those of potassium thiocyanate and potassium hydroxide (cf. these abstracts, 1959, p. 92; 1960, p. 103; 1961, p. 125, 126). The initial rise is hardly observable, but there is again a steep fall in 40-60 minutes. When phenolphthalein is present there is only an initial pink zone at the cathode which does not migrate towards the anode.

Since no insoluble products are formed the steep fall must be due to formation of an almost electrolyte-free zone between the electrodes. Liberation of sulphuric acid at the anode prevents the movement of the pink zone towards that side.

181. Solvent and Salt effects of the unimolecular solvolysis of t-butyl chloride.

B. B. PANDA and B. NAYAK, Cuttack.

The kinetics of solvolysis of t-butyl chloride have been determined in a number of methanol-water mixtures, *viz.* 80 : 20 (v/v), 75 : 25 (v/v), 70 : 30 (v/v), 65 : 35 (v/v) at two temperatures, at 30° and 40°C. The kinetics have also been studied in the presence of added salts of both 'common' and 'non-common' ion types in two selected solvent compositions, viz. 80 : 20 (v/v) and 75 : 25 (v/v) at two temperatures 30° and 40°C. The Arrhenius parameters and the entropy of activation have been calculated.

The effect of solvent composition on the activation energy, and entropy of activation has been examined. It is found that although the specific rate increases as usual with the increase in the proportion of water in the solvent, the activation energy and the entropy of activation show trends opposite to those expected from the Hughes-Ingold theory of solvent effect. An attempt has been made to explain the anomaly from the stand point of the change in dielectric constant.

The effects of salts on the kinetics are found to be extremely irregular. The results show that they cannot be used as useful tools for distinguishing reaction mechanism of solvolytic reactions.

182. The influence of ultrasonic waves on the adsorption of acids by carbon.

A. K. GHOSH, Calcutta.

Varying quantities of formic acid, acetic acid and oxalic acid were mixed up with requisite amount of water to make the volume in each case to 20 ml. One gm. of carbon was then added to it. The quantity of carbon used were (a) Activated carbon (Pack and Roy), (b) Animal Charcoal (B.D.H.) and (c) Wood charcoal (E. Merck). The mixture was then exposed to ultrasonic waves of frequency 1 Mc/s and power 225 watts/sq. cm. for 30 mins. The content of the vessel was filtered and the liquid titrated for the unadsorbed hydrogen ion with standard alkali (NaOH). Another set of observation were taken with an exposure of 60 mins. The unexposed mixtures were shaken intermittently with hand and after intervals of 30 and 60 mins, the contents of the vessel were filtered and the solution estimated as above. The results show that the ultrasonic waves have neither retarding nor accelerating effect on the adsorption of acids.

183. A Kinetic Study in Furfural Polymerization.

NIRMALENDU DUTTA and P. K. CHOUDHURY, Calcutta.

A Kinetic study in furfural polymerization in presence of orthophosphoric acid (sp. gr. 1·75) was undertaken to determine the rate of polymerization of furfural. The experiment was carried out by treating furfural with orthophosphoric acid (100 gms. of furfural containing 15 gms. of orthophosphoric acid) in an atmosphere of nitrogen at 60 ± 1°C and the amount of polymer formed was determined at regular intervals by the technique of fractional precipitaton in the following way. A known amount (about 2-3 gms.) of the polymerized product was dissolved in acetone and a suitable nonsolvent (water) was added dropwise to the solution to get the polymer precipitated. It was observed that the conversion of the monomeric furfural to its polymeric form was very small even after prolonged period of reaction (7·4% after 168 hrs. of reaction). It was also observed that the rate of the reaction was very slow in the beginning but towards the end it became very fast leading to gelation.

184. Transport number of cadmium and iodide in aqueous solution of cadmium iodide by analytical boundary method.

D. MANGARAJ, S. ADITYA and B. PRASAD, Kharagpur.

The transporlt numbers of Cadmium and Iodide in aqueous solutions of Cadmium Iodide have been measured at 30°C over a concentration range from 0·02N to 0·5N by following cation and anion boundary respectively in Analytical Boundary experiments. The cadmium transport number increases from 0·398 to 0·438 as the concentration changes from 0·02N to 0·05N and then gradually decreases to a value of 0·124 at 0·5N. The Iodide transport number, increases gradually from 0·548 to 0·90 as the concentration changes from 0·02N to 0·4N. Transport number measurements using Hittorf's method have been undertaken at three concentrations at 30°C and the values so obtained compare favourably with the values obtained by anion boundary. The increase in Iodide transport number, decrease in Cadmium transport number and the discrepancies shown by cation boudary results have been satisfactorily explained on the basis of relative distributions of positively and negatively charged complexes at different concentrations of Cadmium Iodide and their effect on material transport number.

185. Butanolysis of Oils.

S. K. K. JATKAR and (Miss) M. V. NATEKAR, Poona.

Butanolysis of cocoanut, olive and castor oil has been studied in the presence of BuONa at 25° and 35°C. The velocity coefficients for these second-order autocatalytic reactions decreased in the order : cocoanut, castor and olive oil. The latter two oils were also butanolysed at 0°C.

186. Crystal growth studies on naphthalene.

R. M. MALLYA, Bangalore.

The influence of diffusion and mass transport on the growth form of naphthalene from vapour is presented. The two-dimensional nuclei formed on glass change over to surface dendrites. The influence of temperature and supersaturation on the growth forms of these crystals has been studied. The change of form from whiskers to platelets, dendritic crystals and foliated crystals has been studied.

187. Acetylacetone complexes of cadmium and lead—a polarographic study.

A. K. SUNDARAM, Bombay.

A polarographic study of cadmium and lead in acetylacetone medium has been carried out. The half-wave potentials are measured at different pH. From the shift in the half-wave potentials as a function of free acetylacetonate ion, the pH values from the cadmium and lead complexes have been calculated to be 6·12 and 6·32 respectively.

188. On the behaviour of lead in iodide medium at the dropping mercury electrode—II. an A. C. polarographic study.

A. K. SUNDARAM, Bombay.

An a.c. polarographic study of lead in the iodide medium has been carried out to confirm the observations by the conventional method on the irreversible nature of the waves obtained by the earlier workers. At low concentrations of lead, a single reversible wave and at moderate concentrations, an irreversible wave were observed but at fairly high concentrations, two d.c. waves were obtained. The second wave was attributed to the adsorption of the lead iodide complexes at the electrode. The results by the a.c. method generally confirm these observations. Corresponding to the d.c. waves, three peaks are obtained : the first peak due to the differential of the first step and the second and third peaks due to a combined tensammetric-polarographic process.

189. Infrared, near infrared and Raman Spectra of polyatomic molecules and its correlation with N.M.R. Spectra.

S. K. K. JATKAR, N. C. GUJRATHI and A. J. MUKHEDKAR, Poona.

Infrared, near infrared and Raman Spectra of methylene chloride, chloroform, methyl alcohol, ethyl alcohol, n. propyl alcohol, and butyl alcohol; ethylene dichloride and tetrachloroethane; benzene, toluene, nitrobenzene, aniline, mono chloro, bromo and iodo-benzene, o-dichlorobenzene; coumarin, pyridine, quinoline, isoquinoline, α picoline, thiophene, furan, and cyclohexane have been studied using DK_2 and IR_4 Beckman Spectrophotometers. The results show the remarkable correlationship between N.M.R. spectra on one hand and the infra, near infra and Raman spectra on the other. A further correlationship has been shown between the variations in the bond moments by the component law and the parallel relationship between the frequencies of C-H with C-C bonds.

190. Catalytic properties of some metallic sesquioxides.

K. S. DE, Kharagpur and Bristol, U.K.

Hydrogen-deuterium exchange reaction was studied over Ti_2O_3, V_2O_3, Cr_2O_3, La_2O_3, and In_2O_3. It was normally carried out in a static system using a hydrogen-deuterium mixture of ratio 3 : 1 between 0°C and 500°C and 1-2 cm. pressure. The course of the reaction was followed by withdrawing small amounts of the reactants at regular time intervals and analysing the samples in a mass spectrometer. Relative activities of the oxides have been compared from the rate constants and it has been shown that at lower temperatures Ti_2O_3 and V_2O_3 have comparable rates, while Cr_2O_3 possesses higher activity. Activation energies have also been derived for the first three oxides and it has been found that V_2O_3 has a higher activation energy (15·2 Kcal/mole) than titanium sesquioxide (6·1 Kcal/mole) and chromium sesquioxide. The oxides La_2O_3 and In_2O_3 have been found to be appreciably reduced under the experimental conditions.

The results as a whole are discussed within the context of activity patterns being related either to the extent of d-shell occupation or to semi-conductor type. For H_2—D_2 exchange on Ti_2O_3, V_2O_3, and Cr_2O_3, the results appear to support Dowden's view that the activity of the oxides is related to the number of unpaired d-electrons of the metal ion.

191. Studies in the reaction between lead nitrate and sodium nitrite : Magnetic Susceptibility and Faraday Rotation Measurements.

D. G. VARTAK and M. B. KABADI, Bombay.

The reaction between lead nitrate and sodium nitrite in acqous solution has been studied by measuring the magnetic susceptibilities and Faraday rotations of the different mixtures containing the reacting substances in various molar proportions. It has been concluded from the study that the two salts combine to form in solution a compound with the composition $Pb(NO_3)_2 . NaNO_2$.

192. The high pressure reaction between p. Dioxane, Carbon Monoxide and water.

T. VENUGOPALA CHARLU and M. R. A. RAO, Bangalore.

n-propionic acid has been found to be the primary product of the reaction between p-dioxane, carbon monoxide and water at high pressures. Not even a trace of succinic acid was detected in contrast to the results of J. W. Reppe. Small quantities of simple esters and liquid hydrocarbons were also found in the reaction product. The gaseous products contained considerable quantities of CO_2, unsaturated hydrocarbon—mainly ethylene—and saturated hydrocarbons. An optimum conversion of 42% of dioxane into propionic acid was obtained at a dioxane to water ratio of 1 :2, a maximum pressure of 4000 psi and a temperature of 270°C in the presence of 1 gm of iodine as catalyst. No acid was formed in the absence of the catalyst. Various other catalysts have also been tried. 1 gm of iodine was however found to be the best catalyst.

The reaction probably proceeds through the pyrolysis of dioxane to ethylene and the subsequent reaction of ethylene with carbon monoxide and water to form propionic acid.

193. An apparatus for the preparation of single crystals from the melt.

SUNIL K. DATTA, Calcutta.

An apparatus has been designed and locally constructed for the preparation of pure and doped single crystals from the melt. This involves gradual withdrawal of a single crystal seed dipped in the melt of the corresponding material, both being maintained at proper temperatures. A water-cooled pure nickel pulling shaft was used to raise the seed. A 1-rpm synchronous motor along with a clock-work gear system gave the desired speed reduction, the pulling rate being 5 to 20 mm/hr. A proper control of the temperature of the melt and the rate of flow of heat from the seed which are of critical importance in the initial stage of the growth was attained by adjusting the furnace temperature and water flow in the nickel shaft. An optical system was devised to observe the growth of the crystal during the experiment. Annealing was performed *in situ,* the crystal being detached from the seed and put over the solidified melt. Single crystal 'boules' of about 2 cm diameter and 1·5—2 cm length were grown by this method.

194. "Study of the system lanthanum—Mandelate".

P. L. KACHROO and ARUN K. BHATTACHARYA, Saugar.

The reaction between lanthanum chloride and mandelic acid has been studied by employing the electrical conductance data. A 1 :1 ratio is indicated by the monovariation method with two different compositions of both the solutions. This has been confirmed by the Job's method of continuous variation with two different compositions and in both the cases maxima are observed at the ratio 1 :1. The value of dissociation constant of the above complex has been found by the Job's method which comes to $2{\cdot}81 \times 10^{-3}$ at 26°C.

195. Formation of Thallous Tartarate complex.

K. N. SAHU and ARUN K. BHATTACHARYA, Saugar.

A 2 :3 complex between thallous nitrate and tartaric acid has been found to exist in solution. This has been established by the monovariation method with both pH and electrical conductance measurements for different compositions of thallous nitrate and tartaric acid. This has been next confirmed by the Job's method of continuous variation using electrical conductance data for two different molarities of the two solutions.

The value of dissociation constant of the complex was determined by Job's method by employing conductivity data for four different sets. The average comes to $4{\cdot}606 \times 10^{-12}$ at 28°C.

196. "Formation of Thorium Sulphosalicylate complex".

D. D. SHARMA and ARUN K. BHATTACHARYA, Saugor.

Thorium (iv) has been found to form a 1 :1 complex with 5-sulphosalicylic acid. This has been first established by the monovariation method taking pH and electrical conductance as the physical properties. Job's method of continuous variation gives a further support to the 1 :1 complex from conductivity data used as an indicative property. Same results are obtained for different compositions of the two solutions.

The value of the dissociation constant of the thorium sulphosalicylate complex has been calculated by the Job's method with conductivity data. The average value comes to $3{\cdot}70 \times 10^{-8}$ at 28°C.

197. Physico-chemical study of precipitates by Job's continuous variation method". Part II: Precipitation of Cerous Tungstate.

M. C. SAXENA and A. K. BHATTACHARYA, Saugar.

The precipitation of cerous tungstate has been studied by means of monovariation as well as Job's continuous variation methods.

The investigation of the system by applying the monovariation method was done in two ways : (i) keeping the concentration of cerous chloride constant and varying that of sodium tungstate, and (ii) vice-versa. The pH and conductometric data revealed the formation of normal cerous tungstate, $Ce_2(WO_4)_3$.

Conductometric study of the system by applying the method of continuous variations at three equimolar concentrations of the reactants (M/30, M/40, and M/60) confirmed the above result. It appears that the method of continuous variations can be applied in studying the composition of insoluble substances.

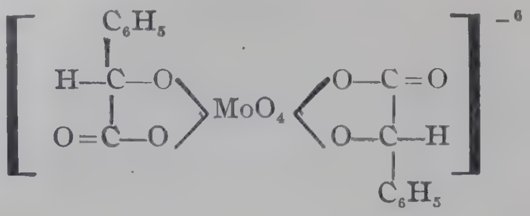
198. "Physico-Chemical study of complex formation of sodium molybdate with organic ligands". Part I: With mandelic acid.

S. P. BANERJEE and ARUN K. BHATTACHARYA, Saugar.

An electrometric study of the reaction between sodium molybdate and mandelic acid has been undertaken. pH and electrical conductance data show a 1 :2 complex between sodium molybdate and mandelic acid for different compositions of the two solutions. Job's method of continuous variation was then employed to confirm the stoichiometry by studying the conductivity of different sets of equimolar solutions of the two.

The value of dissociation constant has been calculated by taking non-equimolar solutions which comes to $4{\cdot}82 \times 10^{-8}$ at 28°C from conductivity results.

The following structure of the molybdo-mandelate complex has been advanced :



199. "Studies in Chromium tellurate sol."

K. T. MANDLOI and ARUN K. BHATTACHARYA, Saugar.

Chromium tellurate sol was prepared by adding 0·5% potassium tellurate to about 13% solution of chromium chloride. The exact values were obtained by trial. It was found to give a transparent gel in ten days.

Various physical property values were measured during the course of dialysis. It was observed that electrical conductance, refractive index, pH and density values first decrease and as the dialysis progresses the values become constant. Surface tension values gradually increase, whereas viscosity values generally decrease.

200. "Study of para-amino salicylate complex of manganese (II) by conductometric and spectrophotometric measurements".

M. S. KACHHAWAHA and Arun K. BHATTACHARYA, Saugar.

Complex formation has been studied between manganese chloride and sodium p-amino salicylate. A 1 : 1 complex has been established by means of the Job's method of continuous variation employing conductometric and spectrophotometric data. Only one complex is found by studying the reaction at different wave lengths.

The value of dissociation constant for the complex was calculated by the Job's equation and was found to be $5{\cdot}7 \times 10^{-4}$. A possible structure for the complex was advanced based on theoretical and experimental results.

201. "Study of the hydrous cobalt oxide".

S. K. AWASTHY and ARUN K. BHATTACHARYA, Saugar.

When sodium hydroxide is added to a solution of cobalt nitrate the amount of alkali needed for complete precipitation of cobalthydrousoxide was found to be less than two equivalents. This was arrived at by examining the supernatant liquid obtained by centrifuging different samples containing varying amounts of the alkali. pH and conductometric data also support the above conclusion.

On ageing the value of conductance increases before the equivalence point while it decreases in presence of excess alkali. pH values go on decreasing with age till the equivalence point is attained, whereas it increases after the addition of more alkali.

202. Spectroscopic and magnetic properties of uranyl and uranous salts.

S. K. K. JATKAR, A. J. MUKHEDKAR, (Miss) R. M. KARNIK
and A. V. KHEDEKAR, Poona.

Ultraviolet spectra and magnetic susceptibility of U(VI) in water, diethyl ether, ethyl acetate, acetone, methyl ethyl ketone, acetic acid, and in nitric, sulphuric and perchloric acids were determined. U(VI) was also studied in thiocyanate medium.

Magnetic properties of U(IV) complexes (solids) and their ultraviolet spectra in acid solutions were determined. For the magnetic measurements, Gouybalance and Curie-balance were assembled in the Department. U(IV) complexes were prepared by photolysis of the corresponding U(VI) complexes in different solvent mixtures.

The spectra and magnetic measurements of U(IV) complexes show two unpaired electrons in 5f level. However, U(IV) formate and acetate gave anomalous results; the complex formed after photolysis of U(VI) formate shows the formation of uranous-uranyl complex, as observed from the ultraviolet spectra and the magnetic susceptibility.

The spectra and magnetic properties of uranyl nitrate, sulphate, and acetate were determined in different organic and inorganic solvents mentioned above. It is observed that the nature of the ultraviolet spectra (band position, sharpness, and shape) goes hand in hand with the magnetic measurements. The environmental dependence of spectra and magnetic properties are explained in terms of ligand field theory.

Infrared spectra of uranyl nitrate and acetate crystallised from organic solvents were studied. It is observed that organic solvents form molecular complexes with UO_2^{++}. However, these complexes are labile to pressure, temperature and moisture, reverting to the corresponding hydrates.

203. Infrared spectra of pyrone derivatives.

S. K. K. JATKAR, MISS P. TRAKROO, A. J. MUKHEDKAR, K. G. MARATHI, Poona.

Pyrone and its derivatives were prepared and infra-red spectra were determined. The presence of cannonical structure of γ-pyrone is reflected in the C-H frequency band at 3220 and $2987^{cm^{-1}}$. The bands at $1700\text{-}1600^{cm^{-1}}$ were analysed for C=O and ring vibration. The band at $1640^{cm^{-1}}$ is due to C=O.

The assignments of the ring vibrations are given. The band at $1186^{cm^{-1}}$ for o-hydroxy chromone indicate the presence of hydrogen bonded C—O bond. Three strong bands in the C=O range ($1730^{cm^{-1}}$, $1701^{cm^{-1}}$, $1672^{cm^{-1}}$) for 2-6 dihydroxy γ-pyrone indicate the presence of symmetrical tri-carbonyl structure; however strong band at $1212^{cm^{-1}}$ (γ-OH) shows the presence of modified -OH group.

204. Study of infrared spectra and magnetic susceptibility of binary system.

S. K. K. JATKAR, A. J. MUKHEDKAR and V. S. JATKAR, Poona.

Magnetic susceptibility and infrared spectra of ketones, halogenated liquids and amines were studied in different solvents. It was observed that Kirkwood-Bauer-Magat equation correlating the solvent refractive index and relative change in infrared frequency does not hold good in the systems studied, it only holds good in non-polar solvents. Magnetic susceptibility deviates slightly, but remarkedly from linear relationship. The sign of curvature of the mole fraction-susceptibility curve and the sign and magnitude of relative frequency shift go hand in hand and are correlated to the local interactions.

205. Infrared and Raman Spectra of CX_4 molecules.

S. K. K. JATKAR and N. C. GUJRATHI, Poona.

In the present paper the authors have applied the postulate of inductive coupling by component law to CH_4, CH_3Cl, CH_2Cl_2 and $CHCl_3$ and CCl_4. The frequencies calculated on the basis of component law have been shown to agree well with the observed frequencies.

206. Conductivity of Electrolytes.

S. K. K. JATKAR and A. G. KULKARNI, Poona.

(I)

The authors have studied the conductivity of binary systems in aqueous solutions, using a specially constructed precision conductivity bridge. The following systems are studied.

$CuSO_4-(NH_4)_2SO_4$, $NiSO_4-(NH_4)_2SO_4$,
$CoSO_4-(NH_4)_2SO_4$, and $Cr_2(SO_4)_3-(NH_4)_2SO_4$.

Plots of $\triangle 1/R/\triangle C.C.$ against composition show a large series of peaks at the Stoichiometric ratios, which have been explained on the basis of breaking down of the water structure.

(II)

The conclusion of Attenburg and Gunter (Z. Physik. Chem. 200, 158-61 (1952)) that the conductance of aq. $CuSO_4$ (0·02—0·3M) is unaffected in presence of uttrasonic wares has been confirmed.

ORGANIC

207. Possible Anthelmintic Agents. Part I.

A. B. SEN, S. K. GUPTA and A. SINGH, Lucknow.

It has been postulated that the grouping $-CO-CH=CH-$ is responsible for bactericidal activity in view of this being present in many antibiotics (Marrian et al., J. Chem. Soc., 1947, 1419). Recently, a number of benzylidine acetophenones containing this grouping have also been found to possess anthelmintic activity (Takayanagi, Ann. Rep. Tok. Coll. Pharm., 1954, *1*, 10-15).

A number of benzylidine acetophenones have therefore been prepared with a view to study their anthelmintic activity.

The compounds were prepared by condensing appropriate acetophenones with different aldehydes in 60% potassium hydroxide solution.

The compounds prepared are,—2-2′-5′-trihydroxy-BA*, 2-chloro-2′-5′-dihydroxy-BA, 2-2′-5′-trihydroxy-5-chloro-BA, 2′-4-5′-trihydroxy-BA, 2′-3-dihydroxy-5-tert.-butyl-BA, 2′-hydroxy-2-chloro-5′-tert. butyl-BA, 2-2′-dihydroxy-3-methoxy-5′-tert. butyl-BA (BA* =benzylidine acetophenone).

208. Possible Antiamoebic Agents. Part XVII.

A. B. SEN and S. K. GUPTA, Lucknow.

It has been reported in a recent patent that 4:6-disubstituted-2-amino-s-triazines possess antiamoebic activity (Brit. Pat. No. 708256).

Therefore, a number of similarly substituted s-triazines have been prepared by condensing various nitriles with amidines, with a view to testing their amoebicidal activity.

The following compounds have so far been prepared—4 :6-diphenyl-2-amino-s-triazine, 4 : 6-di-(o-toluyl)-2-amino-s-triazine, 4 :6-di-(m-toluyl)-2-amino-s-triazine and 4 :6-di-(B-naphthyl)-2-amino-s-triazine.

Further work is under progress.

209. Photo-chemical formations of Amino acids in mixtures containing different sources of carbon in presence of Nickel as catalyst.

KRISHNA BAHADUR and RAJENDRA BAHADUR SRIVASTAVA, Allahabad.

The formation of amino acids in the prebiological era was the first step in Biopoesis and the possibilities of its synthesis under natural conditions have been greatly sought. Bahadur in 1954(1) demonstrated the photo-synthesis of amino acids in sterilised mixtures of paraformaldehyde, water and ferric chloride when the mixture is exposed to artificial or sunlight.

After the formation of organic compounds which might have been synthesised by irradiation as suggested by Baly(2) or by atomic radiations as proposed by Calvin(3) or which were initially present on the surface of the earth if the cold origin of Earth by Levin(4) is taken to be true, the possibility of formation of amino acids by even visible irradiations from the sun is much more probable then the formation of the amino acids by electric discharge in the atmosphere when in the remote prebiological era, earth atmosphere contained carbon monoxide, ammonia, hydrogen and methane as suggested by Miller(5). The photo-synthesis of amino acids in water containing organic carbon and mineral catalyst in prebiological era can explain the initiation of the chemico-physical processes leading to the formation of origin of life in an atmosphere which was very much similar to the present one.

Photo-synthesis of amino acids in sterilised aqueous mixtures containing nickel ions as catalyst and different organic compounds as the source of carbon has been studied and it has been observed that tartaric acid, citric acid, adipic acid, benzoic acid, salicylic acid and glucose are good sources of carbon in the photosynthesis of amino acids. However, the photosynthesis of amino acids is much less if sorbitol or succinic acid is used as the source of carbon in these experiments. The most interesting thing is that though the nature of aminoacids synthesised changes a little with the source of carbon compounds, with many organic compounds similar amino acids are formed. Moreover, mostly natural amino acids are formed in these mixtures. This may explain the biopoesis of only a few natural amind acids constituting the whole range of native proteins.

References

1. Bahadur, K. Nature, 173-1131, 1954.
2. Baly, Stephan and Hood., Proc. Roy. Soc. London, 110-212, 1927.
3. Calvin, M, et al—Science, 114-416, 1951.
4. Bevin, B. Yu—"International symposium on origin of life on Earth" held in Moscow, 1957. Pregamon Press, London.
5. Miller, S. L., ibid., pp. 123-135 (1959).

210. Infra-red spectra and crystallinity.

T. K. K. SRINIVASAN, C. I. JOSE and A. B. BISWAS, Poona.

The infra-red spectra of Glycol mono-alkyl ethers in crystalline, liquid and in solution states are reported. The spectra indicates a splitting of the CH_2 rocking mode of vibration at 720 cm^{-1} and of the C-O-C stretching vibration at 1120 ± 2 cm^{-1} in the crystalline state. From a study of the temperature effect on the position of the bands at 893 cm^{-1} and 864 cm^{-1}, it has been shown that the (O-CH_2-CH_2-O) group exists in both the gauche and trans-configuration in the crystalline state.

211. Influences of structural changes on absorption in merocyanines (n=0).

B. K. SABATA and M. K. ROUT, Cuttack.

The present work describes the preparation of some merocyanines (n=0) derived from benzothiazole and quinoline as variable basic nuclei and rhodanine, pyrazolone, thiohydantoin, thiobarbituric acid and isooxazolone as variable acidic nuclei. Their absorption maxima have been determined, and the corresponding deviations calculated from the absorption data. As the deviation factor is a measure of relative basicity and acidity, the relative basicities and acidities of the nuclei used in the preparation of the above merocyanines have been evaluated from the deviation data. As no oxonol of the acidic nuclei, corresponding to the symmetrical methin cyanine (n=0) which is necessary for the calculation of deviation exists, the absorption maximum of the appropriate oxonol has been assumed to be at a hypothetical value about 100 mμ less than that of the monomethin oxonol.

212. Chemical examination of Mundulea suberosa Benth. Part III. Isolation of Mundulone.

A. C. GHOSH and N. L. DUTTA, Poona.

The detailed chromatographic examination of the ether extractive of the root bark of Mundulea suberosa has yielded a number of crystalline compounds including Munetone [J. Ind. Chem. Soc., 1956, *33,* 716; 1959, *36,* 165]. The present paper reports the isolation of a compound, m.p. 179-80° in 0·35% yield, which has been found to be identical with Mundulone [Proc. Chem. Coc. 1959, 150], an isoflavone of novel complexity, obtained from the African variety of Mundulea sericea.

213. Studies in the preparation of Blood Plasma Extenders, Part I: Partial Hydrolytic depolymerisation and fractionation of polysaccharides obtained from local strains.

A. N. DEY, Delhi.

Crude dextran prepared in the laboratories of the National Sugar Institute obtained from local strains of bacterias has been utilised in the present experiments. The crude material has been depolymerised by sulphuric acid, the hydrolysed product fractionated with the help of acetone in different lots and the portion rich in polysaccharides with 1,6-linkages and appropriate molecular weight have been separated and further processed to give materials conforming to the required properties for the clinical type of dextran.

214. Solution polymerisation of ethyl acrylate.

S. B. RATH, S. K. PATRA and D. MANGARAJ, Kharagpur.

The polymerisation of ethyl acrylate was undertaken to study the effect of alcoholic chain length on the different rate constants. Bulk polymerisation at 50°C, using Azo-iso-butyro-nitrile catalyst was found to be accompanied by autoacceleration and gel formation. Hence polymerisation was done in ethyl acetate, using different ratios of monomer and solvent. The rate was followed using a modified capillary dilatometer. It was found to be proportional to the first power of monomer concentration. Using a value of 0·092/minute for K and 31·2 K. Cal mole as activation energy for this catalyst, K_d at 50°C was calculated. Substituting this value in rate equation K/K_t-values were calculated. The mean values $(2{\cdot}77 \pm 0{\cdot}5) \times 10^{6}$ so obtained compare badly with such values for methyl and butyl acrylate (0·202 and 0·17 respectively). Polymerisation of methyl acrylate in 60%, ethyl acetate was undertaken as a check. A value of 0·0895 was obtained for $K_p/K_t^{\frac{1}{2}}$, which compares favourably with literature data. Further work is in progress to check the anomalous results obtained for ethyl acrylate.

215. A note on "A new method for characterisation and estimation of oils and fats."

R. C. TRIPATHY, Puri.

Choudhury and Das Gupta (J. Ind. Chem. Soc. 1931, *8*, 423) have developed a new method for characterisation of oils and fats and estimation of adulteration on the basis of the temperature of evolution of CO_2 and the weight of CO_2 evolved on oxidation with $KMnO_4$. The method, however, has not been found to give reproducible results and the relation between the acid value and the temperature of CO_2 evolution and the quantity of CO_2 evolved as reported by them has not been always found to be correct. The experimental data obtained in the present work are given in the original paper.

216. Search for new antimalarials: Part VIII. Synthesis of Some 1:5-Diarylbiguanides.

A. B. SEN and P. R. SINGH, Lucknow.

In view of the observed antimalarial activity in certain 1:5-diarylbiguanides (Neelakantan, J. Org. Chem., 1957, 22, 1587), twenty symmetrically substituted 1:5-diarylbiguanide-hydrochlorides have been prepared by reacting metanilic acid, naphthionic acid, 3-hydroxynaphthionic acid, sulfanilamide, p-aminobenzoic acid, p-aminosalicylic acid, p-aminophenol, m-chloroaniline, p-bromoaniline, p-iodoaniline, 2:4-dichloroaniline, 3:5-dibromo-4-hydroxyaniline, 3-chloro-4-bromoaniline, 2-methyl-4-iodoaniline, p-anisidine, p-phenitidine, 6-aminobenzamide, ethyl-p-aminobenzoate, p-aminoacetophenone and p-aminoacetanilide with dicyanimide (prepared by the interaction of calcium cyanamide with aqueous cyanogen bromide) in aqueous medium in presence of hydrochloric acid at reflux temperature, with the object of studying the structure activity-relationship. The biguanides have been characterised through their picrates.

217. Alkaloids of Rhazya stricta Decaisne— Rhazinine.

N. ADITYACHAUDHURY and C. R. GHOSHAL, Calcutta.

In a previous communication (A. Chatterjee *et al.*, *Chem. & Ind.*, 1034, 1961) the isolation and some of the properties of four crystalline alkaloids, mps. (i) 141°, (ii) 234-36°, (iii) 285-6°, and (iv) 115-16° (yield, 0·06, 0·015, 0·001, 0·0061 respectively) occurring in the leaves and roots of *Rhazya stricta* Decaisne (Fam: *Apocynaceae*) were reported. The results of a preliminary investigation of one of the two minor bases, m.p. 285-6° (dec.) are described in the present communication. From physical and other data, this alkaloid appears to be new and is designated as rhazinine.

Rhazinine analyses well for $C_{21}H_{26}N_2O_3$, $2H_2O$ (methanol : ethylacetate : :1 :9) and has been separated from its congeners by chromatographic resolution over Brockmann alumina (methanol : chloroform : : 2 :8); R_f, 0·86 (n-butanol :formic acid : water : :12 :1 :7). Rhazinine forms a hydrochloride, m.p. 282-4° (dec.). The base itself is neutral but the hydrochloride is acidic in protonic solvents. Rhazinine exhibits a number of colour reactions strikingly similar to those of nerifoline (A. Chatterjee *et al., Sci. & Cult., 26,* 238, 1960), an alkaloid from *Alstonia neriifolia* (Fam : *Apocynaceae*). It shows selective absorption in the U.V. region : $\lambda_{\text{EtOH}}^{\text{max}}$ 235 (log ε, 3·95) and 297 mμ (log 3·62) characteristic of quaternary alkaloid having $N_{(a)}$-C-$N_{(b)}$ system. The I.R. spectrum is also comparable to that of nerifoline (*loc. cit.*). Structure elucidation of rhazinine is underway.

218. Ind-N-methylation and O-methylation of Wieland-Gumlich Aldehyde, a degradation product of Strychnine.

(Mrs.) A. CHATTERJEE, (Miss) A. DEB and (Miss) B. CHAUDHURY, Calcutta.

Wieland-Gumlich aldehyde, $C_{19}H_{22}N_2O_2$, m.p. 213° (dec), has been synthesised according to the method of Anet and Robinson (*J. Chem. Soc.,* 1955, 2253) with some modifications.

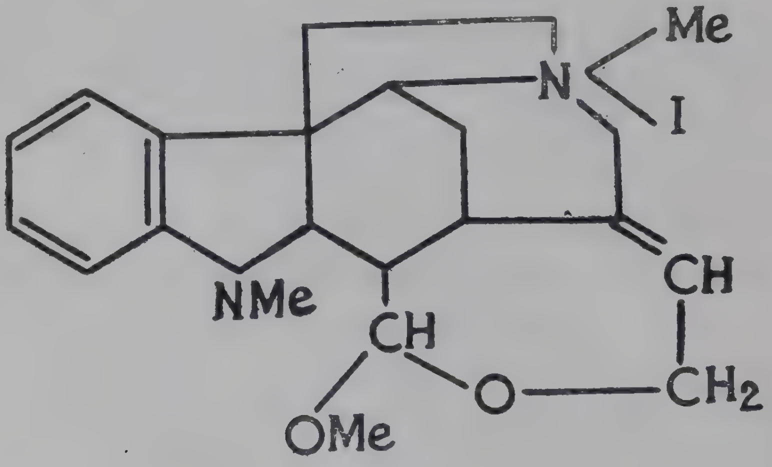
Its methiodide, $C_{20}H_{25}N_2O_2I$, m.p. 310° (dec), was prepared in the usual way and this on treatment with dimethyl sulphate and alkali (Philipsborn, Meyer, Schmid and Karrer, *Helv. Chim. Acta.,* 1958, 1257) gave Ind-N-methyl-o-methyl-N (b) methohydroxide of Wieland-Gumlich aldehyde.

The latter was carefully neutralised with hydroiodic acid and on evaporation in vacuum (10 mm/50°) furnished Ind-N-methyl-o-methyl-Wieland-Gumlich aldehyde-$N_{(b)}$ methiodide(I) along with sodium iodide.

The methiodide was purified by several crystallisations from dry acetone and absolute methanol from which it separated in light, shining, colourless flakes, m.p. 270-71° (dec).

It seems relevant to mention in this connection that during the preparation of Wieland-Gumlich aldehyde an appreciable amount of αα-dichloro methochloride of Wieland-Gumlich aldehyde, $C_{20}H_{23}Cl_3N_2O_2$, $2H_2O$, (does not melt but decomposes above 200°), was formed which confirmed the observations of Smith and Edwards (*J. Chem. Soc.,* 1961, 152).

So, chloroform was replaced by ether during the preparation of Wieland-Gumlich aldehyde for good yield.



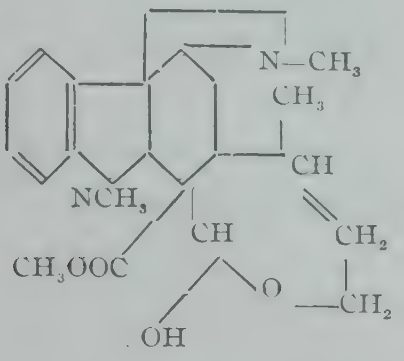
(I)

219. Occurrence of an Allylamine system in Kopsine.

(MRS.) A. CHATTERJEE, (MISS) B. CHAUDHURY and (MISS) A. DEB, Calcutta.

Definite evidence for an allylamine system occurring in Kopsine, $C_{22}H_{2}N_{2}O_{4}$, m.p. 218° (dec), $[\alpha]_D^{25^\circ}+16{\cdot}35^\circ$ (alcohol), an indoline alkaloid of *Kopsia pruniformis* Blume (Apocynaceae) has been provided. Kopsine methiodide, $C_{23}H_{20}N_{2}O_{4}I$, m.p. 200° (dec), on Emde degradation in presence 0·05 N alkali furnished a tertiary base (I), m.p. 210° (dec), which retained all the functional groupings but developed a terminal methyl group which is absent in the parent alkaloid.

This reaction is typical of an allylamine system as shown by Karrer, Schmid & Bickel (*Helv. Chim. Acta,* 1955, 649).



(I)

220. Trinitrobenzene Adducts of Indole and its Derivatives.

(MRS.) A. CHATTERJEE and (MISS) B. CHAUDHURY, Calcutta.

Redemann, Weller and Sell (Redemann, Wittwer and Sell, *J. Amer. Chem. Soc.*, 1951, *73,* 2957; Weller, Rebstock and Sell, *J. Amer. Chem. Soc.*, 1952, *74,* 2690) have developed a method for characterising indole compounds as their 1, 3, 5-trinitrobenzene adducts. This method has been extended by the present authors in characterising indole derivatives produced during the degradation experiments of indole alkaloids. 1,3,5-Trinitrobenzene adducts of indole, 2-methylindole and indole-2-carboxylic acid have been prepared in this connection and their m.ps. and other physical properties are given in Table I.

TABLE I.

Trinitrobenzene derivative of	M.P.	Colour	Crystalline Form.	Solubility in alcohol.
Indole ...	188-89°	Orange	Fine needles	Sparingly soluble in cold but soluble in hot state.
2-Methyl indole ...	183-84°	Brick red	Flakes	Moderately soluble in cold and hot state.
Indole-2-carboxylic Acid.	115-16°	Yellow	Needles	Moderately soluble in cold and hot state.

221. Columbin, the bitter principle of Tinospora cordifolia Miers.

S. GHOSH and (MRS.) A. CHATTERJEE, Calcutta.

Tinosporine, the furanoid bitter principle of *Tinospora cordifolia* Miers (Fam. *Menispermaceae*) popularly known as "Nimgulancha" was assigned the molecular formula, $C_{20}H_{22}O_6$ or $C_{21}H_{24}O_7$ (A. Chatterjee and S. Ghosh, *Sci. and Cult., 26,* 141, 1960). Its acetylation with acetic anhydride-pyridine was unsuccessful. But on treatment with acetic anhydride-sodium acetate it afforded an acetate, m.p. 220-22° (dec.). The physical and chemical properties of tinosporine and its degradative studies suggested the identity of tinosporine with columbin, the bitter principle of *Jatrorrhiza palmata* Miers (D.H.R. Barton and D. Elad, *J. Chem. Soc.,* 2065, 2090, 1956) belonging to the same botanical family *Menispermaceae.* Their identity could subsequently be established from an examination of their (a) proton magnetic resonance spectra and (b) X-ray diffraction patterns.

Occurrence of chasmanthin, m.p. 246° and palmarin, m.p. 256-60°, the companion bitter principles of columbin in *Jatrorrhiza palmata* has also been observed in *Tinospora cordifolia.*

222. Triterpene from the stem bark of Leuconotis eugenifolia.

B. DAS and R. MUKHERJEE, Calcutta.

Investigation of the petroleum ether (b.p. 60-80°) extract of the stem bark of *Leuconotis eugenifolia* has resulted in the isolation of a triterpene, m.p. 179-80 , $[\alpha]_{D}^{30^\circ}+73^\circ$ ($CHCl_3$). Infra-red spectrum of the triterpene shows the presence of hydroxyl band at 3·1 μ. It forms a monoacetate, m.p. 225°, $[\alpha]_{D}^{30^\circ}+68^\circ$ ($CHCl_3$) and a monobenzoate, m.p. 220°, $[\alpha]\frac{30^\circ}{D}+93^\circ$ ($CHCl_3$). Analytical results of the triterpene, its acetate and benzoate are in agreement with the molecular formula $C_{30}H_{50}O$. The acetate forms yellow colour with tetranitromethane indicating the presence of a double bond in the compound. Further investigation for the elucidation of the structure of the triterpene is in progress.

223. Mercurated Dyes, Part IV : Preparation of some mercurated Azo dyes.

V. N. NIGAM, H. L. ROHATGI and A. N. DEY, Kanpur.

The present paper deals with the preparation of some azo dyes obtained by the condensation of O-chloromercuri-p-cresol and monomercurated -α-naphthol with the diazotised bases, viz. 2-methoxy-4-nitroaniline, 2-methoxy-5-nitro-aniline, 2-nitro-4-methyl aniline, o,m,p-nitro anilines, o- and p-toluidines, 5-chloro-2-methyl aniline, and 2-methyl-4-chloro aniline. The mercury atom in these compounds is attached to the part of the dye molecule which has been formed out of the phenol or naphthol utilised in the reaction. The dyeing property of these compounds both for cotton and wool has been examined. Their suitability as rot and mildew proofing agent for textile materials has been also studied. Some of them show good promise for use as a direct dye for wool and also as rot and mildew proofing agent.

224. Chemical Examination of Shorea Robusta : Part I. Isolation of Leucoanthocyanidin.

C. BHEEMASANKAR RAO and V. VENKATESWARLU, Waltair.

Chemical examination of Shorea robusta resulted in the isolation of four chemical constituents : a neutral compound, m.p. 90-92°, two triterpenes m.p. 304-6° and

327-29° and a leucoanthocyannidin, m.p. 280°, having the molecular formula $C_{15}H_{14}O_7$, $2H_2O$. It formed a hexaacetate, a tetramethyl ether and a diacetate of the methyl ether. Boiling with dilute hydrochloric acid gave cyanidin chloride. Oxidation of the methyl ether with potassium permanganate gave veratric acid while with sodium meta periodate, veratric aldehyde and di-o-methylphloroglucinaldehyde were obtained. From these considerations, the leucoanthocyanidin is identified as (+)-5,7,3′,4′-tetrahydroxyflavan-3,4-diol. The nature of the other constituents is still under investigation.

225. Bomination at allylic carbon atom : Uses of Pyridine-bromine complex.

D. M. PATKI and M. G. MARATHEY, Amravati.

Pyridine-bromine complex has been found to effect substitution analogous to N-bromosuccinimide. Present work deals with bromination at the allylic carbon atom. 4-Methyl-7-hydroxy-8-allyl coumarin on treatment with pyridine-bromine complex gives a bromocompound identical with that obtained by the action of NBS indicating the bromination at the allylic carbon atom. The bromocompound on treatment with sodium hydroxide solution gives a compound free from bromine and giving no colouration with $FeCl_3$. This compound was found to be different from 7 : 8 dihydro furano and 7 : 8 furano derivative of 4-methyl-7-hydroxycoumarin.

226. Chemical examination of Vetiver Oil (Bharatpur) isolation and characterisation of a new Sesquiterpene Alcohol, Khusinol.

(MRS.) A. A. RAO, K. K. CHAKRAVARTI and S. C. BHATTACHARYYA, Poona.

A systematic chemical examination of Bharatpur variety of vetiver oil (*Vetiveria zizanioides*) has been undertaken. By subjecting the oil to elaborate column chromatography on neutral alumina two crystalline sesquiterpenic alcohols have been isolated along with other products. Alcohol (m.p. 86-87°, $[\alpha]_{D}^{26^\circ}$ $-174°4$) have been named khusinol. On the basis of U.V., I.R. and degradative experiments, khusinol has been assigned a cadalenic structure with two double bonds, one of which is methylenic and the other trisubstituted. The latter is allylic to the secondary alcoholic group present in it. The other alcohol (m.p. 101-102°) is identical with khusol.

227. Isoquinoline Derivatives : Part XII—Potential Antispasmodics related to Papaverine and Atropine.

BINAY KUMAR GHOSH and T. N. GHOSH, Calcutta.

Methyl 1, 3-dimethyl-3, 4-dihydro-3-*iso*quinolyl ketone has been prepared and its oxime has been reduced to 1, 3-dimethyl-3-α-aminoethyl-1, 2, 3, 4-tetrahydro*iso*quinoline. β-Diethyl-aminoethyl 1, 3-dimethyl-3, 4-dihydro*iso*quinoline-3-carboxylate and the corresponding 1-benzyl analogue have been synthesised. 1-Chloromethyl-3-methyl*iso*quinoline has been prepared and condensed with some primary and secondary amines. Phenylacetic acid ester and β-phenylpropionic acid ester of 3-methyl-*iso*quinolyl-1-carbinol have been prepared. Some of these compounds embrace the structural features of both papaverine and atropine in the same molecule.

228. Isonicotinyl Hydrazones as potential Antitubercular Agents.

T. N. GHOSH and U. P. BASU, Calcutta.

Recently the British Medical Research Council has made an interesting observation (*cf. Tubercle,* 1960, *41,* 399), based on a controlled trial, that a combination of isoniazid (200 mg.) with thiacetazone (150 mg.) offers some definite advantages in the treatment of tuberculosis. This observation has stimulated the preparation of *p*-acetylaminobenzaldehyde isonicotinyl hydrazone. This hydrazone is claimed to have been prepared by Russian as well as American workers but there is discrepancy in the melting point, as recorded by them. This hydrazone has now been prepared by reacting *p*-aminobenzaldehyde with isoniazid and subsequent acetylation of the resulting product. Thus prepared, the compound melts at 287-288° and its ultraviolet spectrum $\left\{\begin{matrix}(0\cdot1\text{N})\ \text{NaOH}\ 330\ \text{m}\mu\ (\log\varepsilon\,4\cdot33)\\ \lambda\ \text{max.}\end{matrix}\right\}$, which is found to be similar to that $\left\{\begin{matrix}(0\cdot1\text{N})\ \text{NaOH}\ 330\ \text{m}\mu\ (\log\ \varepsilon\ 4\cdot48)\\ \lambda\ \text{max.}\end{matrix}\right\}$ of thiacetazone, points to the purity of the compound.

229. Isoquinoline Derivatives as possible Amoebacides. Part IV.

SUNIL KUMAR GANGULY and T. N. GHOSH, Calcutta.

N-β-Phenethyl-cyanoacetamide has been cyclised with phosphorus pentoxide to furnish 1-cyanomethyl-3-, 4-dihydro-*iso*quinoline. The latter has been reduced with sodium and ethanol to yield 1-(β-aminoethyl)-1, 2, 3, 4-tetrahydro*iso*quinoline. Some alkyl- and arylmalondi-α-alkyl (or aryl)-β-phenethylamides have been prepared and cyclised with phosphorus pentoxide in boiling toluene to yield the corresponding 1,1′-alkyl (or aryl)-methylene-*bis*-3-alkyl (or aryl)-3, 4-dihydro*iso*quinolines, which could be dehydrogenated over Pd-C in tetralin at 240° to the corresponding fully aromatised *iso*quinolines.

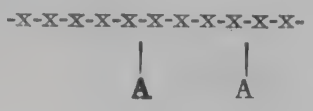
230. Methylation studies of Araboxylan isolated from the Pea-skins (Pisum-Sativum).

C. V. N. RAO and N. BANERJI, Calcutta-32.

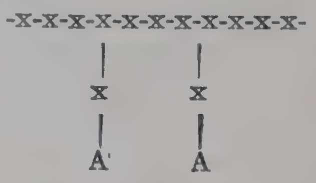
The completely methylated polysaccharide gave on hydrolysis, 2, 3, 5-tri-O-methyl Arabinose, 2,3-di-O-methyl Xylose, 2-O-methyl Xylose and traces of D-xylose and 2, 3, 4-tri-O-methyl Xylose.

The ratio of different methylated sugars was found to be : trimethyl Arabinose : dimethyl-Xylose : mono-methyl Xylose = 1 : 4·4 : 1·1.

On the basis of the methylation results two probable structures (I and II) may be put forward for the repeating unit of the polysaccharide :



I



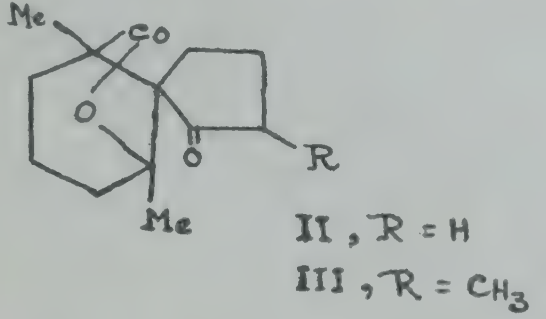
II

Structure I was found to be correct as, on mild hydrolysis, L-arabinose was removed leaving a Xylan chain with very few arabinose units attached to the main chain. Periodate-oxidation studies on both the original and degraded polysaccharides and estimation of sugar residues unattacked by periodate lead to the confirmation of the structure I.

231. An unusual Ring-Closure with Polyphosphoric Acid.

P. C. DUTTA, S. L. MUKHERJEE and (MISS) D. MUKHERJEE, Calcutta.

The present investigation deals with experiments leading to the synthesis of the keto-lactone (III) incorporating a cyclopentanone ring as a result of an unusual type of ring-closure, during the attempted synthesis of an important degradation product of marrubiin (I).



An unambiguous synthesis of 3-methyl-3-carboxy-2-(γ-carboxypropyl)-cyclohexanone, m.p. 161°, was carried out in this laboratory which was subsequently utilized in the present investigation. The above acid was esterified to the corresponding di-ester which was allowed to react with methylmagnesium-iodide. The Grignard's reaction product was dehydrated to afford 1 :3-dimethyl-3-carbethoxy-2-(γ-carbethoxypropyl)-Δ^{1}-cyclohexene. It was then subjected to partial hydrolysis and subsequent cyclisation of the acidic material furnished 3-hydroxy-1 : 3-dimethyl-2-(γ-carboxypropyl)-cyclohexane-1-carboxylic lactone in the acidic fractions and the keto-lactone (II; m.p. 159-160°) in the neutral fractions along with γ-(2-hydroxy-1 :3-dimethyl-1-carbethoxy-cyclohexyl-2-)-butyric acid lactone.

The keto-lactone (II) was methylated at the α-position to the carbonyl function through formylation, acetylations and catalytic reductions. The methylated keto-lactone (III; m.p. 128-129°) showed bands at 5·65 μ (s); 5·76 μ (m) in infra-red. Experiments are being conducted to study similar systems to evaluate the steric influence of the groups in directing this type of ring-closure.

232. Synthetic Studies in Terpenoids.

S. K. MUKHERJEE, C. T. MATHEWS, (MRS.) C. DUTTA and
(MISS) G. SEN GUPTA, Calcutta.

In the course of total synthesis of bicyclic diterpenoids the preparation of 6 :6-Ethylenedioxy-1 :1 :10-β- trimethyl- Δ^{5}-octal-2-one (I) (Narang and Dutta, J.C.S., 1960, 2842) has been considerably improved by using Mannich base method. The decalone (I) was purified by chromatography over alumina and eluted with petroleum ether (40-60°C). This was reduced by Wolf-Kishner method to form an oil which was deketalised with acetone in presence of p-toluene sulphonic acid. This on catalytic reduction in presence of platinum oxide afforded an oil b.p. 100°C/0·5 mm. which was further characterised through a semicarbazone, m.p. 220-222°C. Further investigations are in progress to build up the aliphatic C_{4}-chain present in the resin-acids at the proper position of the decalone.

233. Synthetic Investigations in Diterpene Alkaloids.

H. S. SURI, A. K. KUNDU, O. S. BHANOT and A. BANERJEE, Calcutta.

Recently exhaustive works were carried out in the structural elucidation of Garrya-type alkaloids of diterpene group (Weisner *et al.* Chem. & Ind., 1957, 173;

Auet *et al*, Canad. J. Chem., 1957, *35*, 397). Stereospecific synthetic projects have been undertaken in this laboratory to synthesise these type of alkaloids. The present communication describes the synthetic investigations of a model compound having the heterocyclic ring related to the diterpene alkaloids.

Potassium cyanide was added to 3-methyl-cyclohexanone and the resulting product afforded 1-methyl-1-cyano-cyclo-hexan-3-one (I) along with a dicyano-compound. The dicyano-compound on hydrogenation and hydrolysis furnished 1-methyl-1, 3-dicarboxycyclohexane. The compound (I) was subjected to Reformatsky's reactions with bromo-acetic ester and on subsequent dehydration yielded 1-carbethoxy methyl-3-methyl-3-cyanocyclohexane (II) or its bond isomer which was then catalytically reduced to 1-carbethoxymethyl-3-methyl-3-cyanocyclohexane (III). The cyclopentanone ring was next developed by cyclisation of the cyano-ester (III) and the resulting bicyclic-ketone (IV) afforded a colourless liquid (b.p. 95-96°/24 mm.) having a camphoraceous odour. Attempts are being made to rearrange the oxime of the bicyclic ketone (IV) to the desired -C-N-C-bridge present in A/B rings of these alkaloids.

234. Preparation of Anilino Malonates.

P. N. MOZA and B. G. CHATTERJEE, Khara[illegible]ur.

The conventional method for the condensation of anilines and bromomalonate has been modified to afford the high yields of the corresponding anilino malonates in shorter period. The reactions were carried out without a solvent at 50—60°C at a slightly reduced pressure (40—50 mm.) when the yields obtained were 95%.

235. Paper electrophoretic studies on some Coumarins.

J. DUTTA and B. K. BURMAN, Calcutta.

The coumarins in general dissolve in alkaline solution due to the opening of the lactone ring followed by ionic dissociation. With this picture in view the electrophoretic behaviour of some of the coumarins was studied by means of paper electrophoresis technique. The coumarins used in these studies were coumarin, psoralene, umbelliferone, dalbergin, marmesin and wedelolactone. The alcoholic solutions of the samples were applied at the centre of 40cm × 6cm Whatman No. 1 filter paper strips. The strips were then sandwitched between two glass plates and electrophoresis was carried for about an hour with an applied potential gradient of 10 volts/cm.

The electrolytes used were (1) N/10 NaOH solution and (2) Glycine-NaCl-NaOH buffer system of varying pH.

The results obtained are presented in the following table.

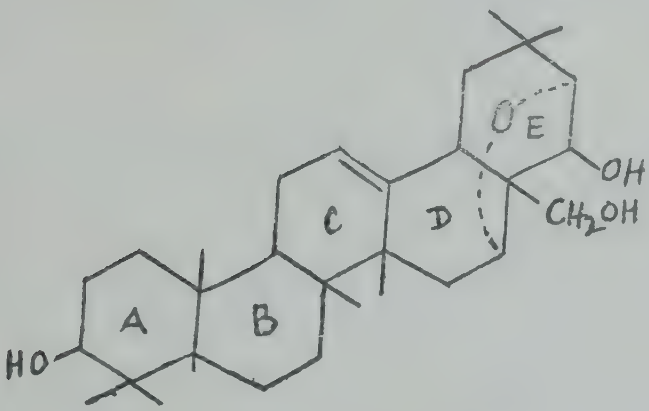
Coumarins	Mobility (cm²/volt × hour)		
	N/10 NaOH solution	Glycine buffer pH 12·7	Glycine buffer pH 8·45
1. Coumarin	−0·90	−0·90	−0·05
2. Psoralene	−0·24	−0·76	0·00
3. Umbelliferone	−0·33	−0·43	−0·33
4. Dalbergin	−0·10	−0·18	0·00
5. Marmesin	−0·15	−0·40	+0·20
6. Wedelolactone	−0·12	0·00	0·00

236. Triterpenoids XII. The Constitution of Barringtogenol D.

SACHINDRA K. CHAKRABORTI and A. K. BARUA, Calcutta-9.

The isolation of Barringtogenol D, a new triterpenoid sapogenol, $C_{30}H_{48}O_4$, m.p. 305-10°, from the fruits of *Barringtonia acutangula* Gaertn has been reported earlier (Barua, Maiti and Chakraborti, *J. Pharm. Sciences, 50,* 1961, in press). This paper describes the structure and stereochemistry of barringtogenol D.

Three of the oxygen atoms of barringtogenol D are present as three alcoholic groups and the fourth oxygen atom occurs as an internal oxide function. Barringtogenol D belongs to the β-amyrin group of triterpenes and the ethylenic linkage present in it shows anomalous behaviour due to the presence of the oxide linkage. From the various oxidative and other reactions and the close similarity of certain behaviours with aescigenin, the structure of barringtogenol D has been assigned as 3β-22β-28-trihydroxy-Δ^{12}-16α-21α-oxido oleanen (I). This structure has been confirmed by converting barringtogenol D into a deoxy compound, $C_{30}H_{48}O_2$, m.p. 198-200°, which forms an acetate, $C_{32}H_{50}O_3$, m.p. 201-03°. The identity of these compounds with 22β-hydroxy-Δ^{12}-16α-21α-oxido-oleanen and its acetate respectively Cainelli, Melera, Arigoni and Jeger, *Helv. Chim. Acta, 40,* 2340, 1957), coupled with the chemistry of barringtogenol D finally establishes its structure and stereochemistry as (I).

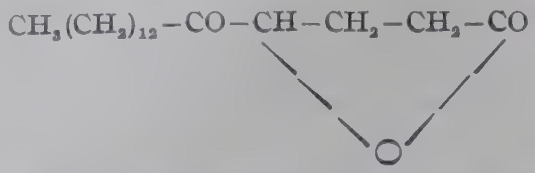


(I)

237. Isolation and study of a Ketolactone from the bark of Feronia elephantum.

R. D. TEWARI and J. P. TEWARI, Allahabad.

From the stem bark of the plant Feronia elephantum a compound $C_{18}H_{32}O_9$ (m.p. 115°C), has been obtained by extraction with ethanol. The compound gives all the tests of a ketone, forms a 2 :4 dinitrophenylhydrazone and gives peaks at 1136 cm.$^{-1}$ and 1479 cm.$^{-1}$ in the I.R. spectra. It has been found to dissolve in hot sodium hydroxide and on acidification of the solution the original compound is precipitated back. It gives a characteristic peak at 1754 cm.$^{-1}$ for a lactone. The reaction with HBr, HI and esterification with methanol forming ester of an hydroxy acid, all show the presence of a lactone structure. On oxidation with nitric acid it forms a fatty acid $C_{14}H_{28}O_2$ which has been found to be myristic acid and the other acid left in the aqueous solution has been identified to be succinic acid. The compound appears to be lactone of the formula



Experiments for the confirmation of this structure are in progress.

238. Chemical examination of the berries of Solanum nigrum Linn.

S. S. NIGAM and G. C. JAIN, Saugor, M.P.

The glyceride structure of the fixed oil from the dried berries has shown the presence of disaturated oleins 3%; saturated oleo linoleins 6%; di-oleolinoleins 46%, and oleodi-linoleins 45%. Two hydrocarbons, pentetriacontane, and tricontane and two sterols β-sitosterol and dihydrosterol have been isolated from the unsaponifiable matter of the oil.

The defatted berries yield a steroidal saponin $C_{45}H_{84}O_{22}$, m.p. 220° (decomp.), which on hydrolysis gives a sapogenin, $C_{27}H_{48}O_4$, m.p. 198-199°, and three sugars, rhamnose, glucose, and galactose.

The glucoalkaloid, solasonin, m.p. 275-279°, and the alkaloid solasodin, m.p. 201-202° have also been isolated from the berries, and so also glucoside rutin, m.p. 260° which on hydrolysis gave quercetein, m.p. 314° and two sugars—glucose and rhamnose.

239. Studies on Halogenation of Benzalacetophenones-1—Bromination.

S. Y. AMBEDKAR, S. D. JOLAD and S. RAJAGOPAL, Dharwar.

A study of the bromination under controlled conditions of polyhydroxychalkones (partially alkylated) carrying reactive hydroxy groups in the ketonic half of the molecule has been made. The results are in agreement with the observations of Jadav and coworkers that nuclear bromination (at the 5′ position if this were free and at the 3′ position if the former be already substituted) precedes addition at the double bond when only one molecular proportion is employed. However with two or more molecular proportions of bromine or with liquid bromine addition as well as nuclear bromination take place. An electronic interpretation of the preferential nuclear bromination over addition at the double bond has now been offered.

240. Estimation of Nickel and Palladium by Semicarbazone of α-oximino Acetoacetanilide.

B. N. MANKAD and M. R. PATEL, Vallabh Vidyanagar.

αβ-dioximes are known for their wide application in the detection, separation and estimation of Palladium and Nickel. Dave and Talati (J. Ind. Chem. Soc. 1959, *36*, 179; ibid, 1959, *36*, 302) used αβ-dioximino acetoacetanilide for the estimation of Palladium and Nickel. It was therefore proposed to investigate the utility of semicarbazone of α-oximino acetoacetanilide as an analytical agent.

It was observed that Palladium forms a yellow complex and Nickel forms light yellow to red complex. The colour of Nickel complex varied with the change in pH. By analysis it is found that the complexes have the following compositions.

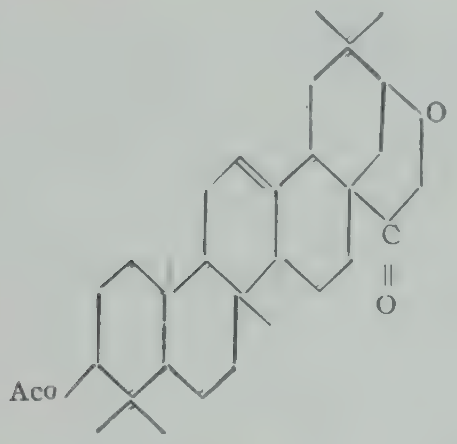
(i) $Pd(C_{11}H_{12}N_5O_3)_2$ Yellow.
(ii) $Ni(C_{11}H_{12}N_5O_3)_2$ Light Yellow.

Further work on other semicarbazones of α-oximino compounds of substituted amides of aceto-acetic acid is in progress. Thio-semicarbazones of the same compounds are under the process of investigation.

241. The study of Maharashtrian Albizzia Procera, Benth. Seeds.

I. P. VARSHNEY and Mohd. S.Y. KHAN, Aligarh.

The seeds of Albizzia procera Benth from Maharashtra yield a new saponin and sapogenin quite different from Proceranin and Machaerinic acid obtainable from Madhya Pradesh seeds (Arch. der Pharm. 1959, *292*, 57-62; Compt. rend., 1958, *246*, 3261-63; Current Sci., 1958, *27*, 489). The acetate of the genin, m.p. 288-90°, obtained by the hydrolysis of the saponin has been assigned the following tentative structure, and tentatively named Proceric acid.



242. High Resolution Nuclear Magnetic Resonance Spectra of Coumarins.

S. S. DHARMATTI, C. R. KANEKAR, C. L. KHETRAPAL and Y. P. VIRMANI, Bombay.

The high resolution proton magnetic resonance spectra of fourteen coumarin have been studied and compared with the theoretical spectra of the type AB, ABC and ABCD. Chemical shifts for protons in various positions in the Benzo-α-pyrone ring and spin coupling constants between these protons have been determined from such analysis. The spectrum of coumarin confirms the ethylenic nature of the double bond between carbon atoms in positions 3 and 4. The chemical shifts for the phenyl protons are in conformity with the reactivities of the coumarins at various positions in the ring. A linear relation has been observed between the chemical shift for proton in 8 position in various 6-substituted coumarins and the Hammett's δ Constants for substituents in the meta position. The NMR spectra offer a very convenient method for distinguishing between 3 and 4 substituted coumarins on account of the large chemical shift between the protons in 3 and 4 positions.

The results do not indicate resonance of the naphthalene type as suggested to explain the dipole moment of coumarin.

243. Application of physical methods to the analysis of essential oils. Part IV: Ultra violet absorption spectroscopy.

S. S. NIGAM and (MISS) G. LAKSHMI KUMARI, Saugor, M.P.

Absorption maxima of anethole ($\lambda_{max}=260$ mμ, $\varepsilon=18{,}600$), methyl cinnamate ($\lambda_{max}=272$ mμ, $\varepsilon=33, 930$), citral ($\lambda_{max}=244$ mμ, $\varepsilon=15, 880$), β-ionone ($\lambda_{max}=284$ mμ, $\varepsilon=27{,}800$), pulegone ($\lambda_{max}=224$ mμ, $\varepsilon=30{,}658$), heliotropin ($\lambda_{max}=244$ mμ, $\varepsilon=42{,}330$), and methyl anthranilate ($\lambda_{max}=230$ mμ, $\varepsilon=10{,}280$) have been determined and the calibration curves of the first four prepared, to enable their estimation in essential oils. Spectroscopic method has been applied to estimate the percentage of anethole in fennel oils, methyl cinnamate in Ocimum basilicum oil and citral in lemon oil. Percentage composition of the mixtures of pulegone and methyl cinnamate, and heliotropin and methyl anthranilate has also been determined spectroscopically with the use of the simultaneous equations (given below) of Fearn.

$$100\times ABE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_1=\%\text{ of } A\times AE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_1+\%\text{ of } B\times BE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_1 \quad \ldots \quad \text{(i)}$$

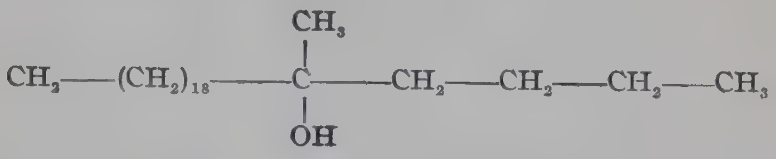
$$100\times ABE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_2=\%\text{ of } A\times AE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_1+\%\text{ of } B\times BE^{1\%}_{1\ \text{cm.}} \text{ at } \lambda_2 \quad \ldots \quad \text{(ii)}$$

for a mixture of two compounds A and B having two maxima at λ_1 an λ_2.

244. Isolation and chemical examination of an aliphatic alcohol from the leaves of Sesbania Grandiflora, Linn. (Agasta).

R. D. TIWARI AND R. K. BAJPAI, Allahabad.

From the leaves of Sesbania grandiflora, Linn., (Agasta) a white, crystalline, aliphatic compound, m.p. 84°C and molecular formula, $C_{26}H_{54}O$ has been isolated. As a result of the analysis and the study of degradation products it has been found to be tertiary alcohol of the formula :



$$CH_3-(CH_2)_{18}-\underset{\displaystyle OH}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}-CH_2-CH_2-CH_2-CH_3$$

245. Diosgenin from *Dioscorea glauca*.

(MRS.) D. CHAKRAVARTI, R. N. CHAKRAVARTI, S. N. DASH and M. N. MITRA, Calcutta.

During 1951-54 a survey work was undertaken in this laboratory on the diosgenin content of the yams of a large number of *Dioscorea* plants growing in different parts of this country. Most of these yams were collected through the various forest offices. It was ultimately possible to find out two rich Indian sources for diosgenin—*Dioscorea deltoidea* (kins) of Kashmir and *Dioscorea prazeri* (kukur torul) of Darjeeling. In the present paper it is desired to deal with isolation of diosgenin from another plant of the *Dioscorea* family growing in Darjeeling, *Dioscorea glauca,* received from the Director, Medical Plants, Government of West Bengal. The yams of these plants are very similar to those of *Dioscorea prazeri* in appearance. The new yams were found to contain about 4·6 per cent of diosgenin.

246. 2-Aminothiazole derivatives.

C. S. MAHAJANASHETTI and K. S. NARAGUND, Dharwar.

A series of 2-amino-4-benzoylthiazoles, having various substituents in the phenyl ring, and their respective 2-acetamido-5-chloromercuri and 2-acetamido-5-bromo derivatives have been prepared with a view to study their chemotherapeutic properties. 2-Amino-4-benzoylthiazoles were obtained by condensing 1-phenyl-3-bromo-1, 2-propanediones with thiourea. 2-Acetamido-4-benzoylthiazoles when treated with $HgCl_2$ solution gave corresponding 5-chloromercuri derivatives which were further converted to 5-bromo derivatives by the action of bromine. Some of the compounds were found active *in vitra tests* against *E. coli* and *S. aureus.*

247. Pyridine analogues of dads.

S. P. ACHARYA and K. S. NARGUND, Dharwar.

Phenyl 5-amino-2-pyridyl and phenyl 5-amino-3-chloro-2-pyridyl sulphides and sulphones having various substituents in the phenyl ring have been prepared with a view to study their pharmacological properties. 2-Chloro-5-nitropyridine and 2, 3-dichloro-5-nitropyridine have been condensed with 2, 4-, 3, 4- and 3, 5-dichlorothiophenols and chloro- and dichloro-p-hydroxythiophenols to obtain corresponding phenyl 5-nitro-2-pyridyl sulphides. These sulphides were oxidised to their respective sulphones employing hydrogen peroxide in glacial acetic acid. The various nitrosulphides and nitro-sulphones were reduced to their corresponding amino-compounds by reduced iron and ammonium chloride. Most of the compounds are bacteriostatic against *E. coli* and *S. aureus in vitro* tests.

248. Ultraviolet absorption studies on Dixanthogens.

M. L. SHANKARANARAYANA and C. C. PATEL, Bangalore.

Absorption spectra of di-ethyl, di-isopropyl, di-n-butyl and di-isoamyl dixanthogens have been studied in the near ultraviolet region in polar and non-polar solvents. These compounds exhibit a low intensity band around 365 mμ and two high intensity bands around 286 and 242 mμ. Based on the solvent effect studies, the 365 mμ band assigned to $n \rightarrow \pi^*$ transition and the 285 mμ to $\pi \rightarrow \pi^*$ transition. The band around 242 mμ is due to the $n \rightarrow \sigma^*$ transition, since in polar solvent it shows mainly a blue shift.

249. A study of kinetics of bromination of cinnamic acid and its derivatives (Part I) in methyl alcohol as a solvent.

A. N. BOSE and V. K. SETH, Lucknow.

The bromination of cinnamic acid and its mono- and di-substituted derivatives was studied in methyl alcohol as a solvent. The rate of reactions was determined at different temperatures. By applying "least square method" for calculating the slope of a line, the energy of activation was calculated by using the values of specific rate constants at different temperatures. From these the values of logarithm of frequency factor, entropy of activation and free energy of activation were calculated. These values were found to be more or less constant throughout the series. The values of energy of activation of each compound were also calculated directly by using Arrhenius equation. Here the values of specific rate constants at a particular temperature, and frequency factor of cinnamic acid were used. These values were found to be in a good agreement with the experimental values of mono- and di-substituted cinnamic acids. The theoretical values of energy of activation of di-substituted derivatives were also calculated by adding the values of energy of activation of cinnamic acid and the substituent groups, and were in corroboration with the experimental value of energy of activation of those compounds. So it can be inferred that the resultant effect of two substituents is simply the sum of their individual effects and the reaction follows the rule of additive effect. By plotting the values of dissociation constants for the acids, for which the values of dissociation constants were available, a definite linear relationship was obtained. Thus the rate of reaction and the dissociation constants of acids were found to be closely related in a linear manner.

250. Application of physical methods to the analysis of essential oils. Part III. Polarography.

S. S. NIGAM and (MISS) G. LAKSHMI KUMARI, Saugor, M.P.

Examination of the polarograms of higher (hexanal to dodecanal) saturated aliphatic aldehydes has revealed that their reduction at the dropping mercury electrode takes place in a number of steps, probably involving the formation of alcohol, through an intermediate. The number of steps increases as the acidity of the buffer added increases. The half-wave potentials of the reduction steps of the 2, 4-dinitrophenylhydrazones of these aldehydes have been found to be almost similar, and thus are not suited for their estimation polarographically. The behaviour of the 3,5-dinitrobenzoates of a few alcohols and phenols have been studied in various buffer solutions. Mostly the reduction appears to occur in two stages, the first involving one electron, the second being irreversible. In addition to these, the polarograms of heliotropin, cyclamen aldehyde, hydroxy citronellal, cineol (1 : 8) and citral have been studied with a view to identify their presence in essential oils polarographically. Citral and cineol have also been quantitatively estimated in a few essential oils with the application of this method.

251. Organic fluorine compounds—Part IV. Electrophilic additions to fluoroallenes.

G. V. ASOLKAR, Nagpur.

The syntheses of stable fluoroallenes and related compounds have been recorded in the earlier communications (Proc. Ind. Sci Congr. 1958-60). This paper concerns the ionic additions and particularly the reactions of electrophilic reagents with these reactive systems.

The trifluoromethyl allene has been studied in some detail. The allene reacts with iodine monochloride and iodine monobromide smoothly to give $CF_3.CH:CI.CH_2X$ ($X=Cl$ or Br) in almost quantitative yields establishing the overall polarisation of the allene as $CF_3.CH:\overset{\delta-}{C}:\overset{\delta+}{CH_2}$. Reaction with chlorine at room temperature gives the dichloro compound $CF_3CH:CCl.CH_2Cl$. Trifluoromethyl allene failed to react with hydrogen chloride up to a temperature of 250-270°C even when anhydrous ferric chloride was used as a catalyst. On the other hand it reacts with hydrogen bromide to give $CF_3.CH:CH.CH_2Br$.

Investigations in the orientation arising when a mixed halogen like iodine monochloride and monobromide is added to an unsymmetrical allene have again yielded corresponding compounds as above establishing the overhaul polarisation of the allene concerned as $CF_3.CH:\overset{\delta-}{C}:\overset{\delta+}{CH}.CH_3$ indicating the interesting reactions due to an electron attracting group at one end and electron releasing group at the other.

The identity of the new compounds presented is established by reference to these or related compounds obtained in the earlier free radical addition reactions studied (loc. cit.), and their infra red and ultra violet spectra.

The study of other allenes and addition of sulphur trioxide to these reactive systems is under progress.

252. High Resolution Nuclear Magnetic Resonance Spectra of some Trisubstituted Benzenes.

S. S. DHARMATTI, G. GOVIL, C. R. KANEKAR, C. L. KHETRAPAL and Y. P. VIRMANI, Bombay.

This paper presents the analysis of the proton magnetic resonance spectra of 2-chloro, 6-nitrotoluene; 2, 4-dinitrophenol; 1-chloro, 2, 4-dinitrobenzene and sodium hydrogen salt of 5-nitro, 3-sulphobenzoic acid. The phenyl protons in all these compounds form a system of 3 nuclei of the ABC type. The analysis has been made using the algebraic expressions given by Jha (Jha, S. S., Proc. Ind. Aca. Sci., 54A, 13, 1961) for the complete solution of the secular equation involved. The values of the chemical shifts and the spin coupling constants have been determined for each compounds by obtaining the best fit between the experimental and theoretical data for frequency separations and the intensities of the resonance lines.

253. Use of thiohydantoins and their mercurated derivatives, as fungicides and bactericides.

A. C. RATH and G. N. MOHAPATRA, Cuttack.

A number of aryl substituted thiohydantoins have been prepared by condensing symmetrical substituted di-aryl thioureas and N-substituted monoaryl thioureas with sodium ethoxide and benzil in presence of sodium acetate. (Angel Guillén, Chem. Abstr., 1951, 612 and Beritsch, 1911, Vol. I, page 411). These thiohydantoins have also been mercurated with mercuric acetate and glacial acetic acid. Since the thiohydantoin compounds contain the N-C-S group and exhibit medicinal, antiseptic and germicidal activities, both the parent thiohydantoin compounds and their mercurated derivatives prepared, have been assayed for antibacterial and antifungal activities.

254. Studies in 'The Cyclo-octane series' part I. The Synthesis of 1-Carboxy-Cyclostane-1-Acetic acid.

G. S. SAHARIA and M. P. TYAGI, Delhi.

In continuation of the earlier work on the study of the chemistry of cyclohexane and cycloheptane rings, we have extended this study to the cyclooctane ring system. The present investigations are devoted to the study of isomerism of the eight membered ring and in this work is described the synthesis of 1-carboxy-cyclooctane-1-acetic acid.

Cyclooctanone was condensed with ethylcycloacetate to give ethyl cyclooctylidene-cyano acetate, which was later condensed with potassium cyanide. This di-cyanoester on hydrolysis with hydrochloric acid gave only one 1-carboxy cyclooctane-1-acetic acid m.p. 154°. The acid was characterised through its anilide, p-toluidide, anhydride, amide and S. benzyl-iso-thiouranium salt. Further work is in progress.

255. Synthetic studies in the indole field. Part II—Some 7-Nitroindole derivatives of biological interest.

S. P. HIREMATH and S. SIDDAPPA, Dharwar.

The synthesis of 7-nitro-3-indoleacetic acid, 7-nitro-β-(3-indolyl)-lactic acid, and aldehydes derived from 7-nitroindole, which are all of biological interest are described in the paper. 3-Diethylaminomethyl-7-nitroindole (I) was converted into its methiodide, m.p. 173-4°, and reacted with sodium cyanide to obtain 7-nitro-3-indoleacetonitrile, m.p. 207-8°, which on hydrolysis gave 7-nitro-3-indoleacetic acid, m.p. 200°, which is of interest as a plant hormone. 7-Nitro-3-indolealdehyde, m.p. 210°, and 7-nitro-2-carbethoxy-3-indolealdehyde, m.p. 180°, have been synthesised and their corresponding thiosemicarbazones prepared with a view to test them for anti-tubercular properties. The compound (I) on reaction with diethyl acetoxymalonate and hydrolysis of the resulting product gave 7-nitro-β-(3-indolyl)-α-hydroxy-α-carboxy-propionic acid, m.p. 170°, which on decarboxylation gave the required 7-nitro-β-(3-indolyl)-lactic acid.

256. Mercurated Dyes, Part V : Preparation of some Azo Dyes.

J. K. SAXSENA, H. L. ROHATGI and A. N. DEY, Kanpur.

In a previous paper of this series (Proc. Ind. Sci. Congr., 1960) we have described the preparation of antifungal properties of some mercurated dyes obtained by coupling diazotised mercurated bases with phenols. In continuation of the same work we have described in this paper the preparation and properties of further samples of the type as were obtained from Scarlet G base (2-methoxy-5-nitroaniline). For the purpose the base was mercurated to furnish a mono-mercurated base which after diazotisation was coupled with phenol, o, m and p-cresole, resorcinol, α- and β-naphthols, Scaffers salt and N W acid. The mercurated dyes were also tested for their fungicidal properties.

257. Mercurated Dyes, Part VI: Preparation of some mercurated Phthaleins.

J. K. SAXSENA, H. L. ROHATGI and A. N. DEY, Kanpur.

In contradiction to what has been noted by earlier workers it was observed that 3-nitro phthalic anhydride on condensation with phenol gives two isomeric phthaleins. They have been separated from each other with the help of different solubilities of their acetyl derivatives in water. Their probable constitution has been indicated. Similarly the same anhydride on condensation with resorcinol also gives two isomeric fluoresceins which were separated through their acetyl derivatives. The dyes obtained from these acetyl products have been brominated and mercurated to give the mercurochrome type of compounds.

4-nitrophthalic anhydride also gives two sets of isomeric compounds with phenol and resorcinol.

The mercurated compounds have been examined for their antifungal properties.

258. Experiments on the Synthesis of cadinene. Part I. Synthesis of 5-methoxy-8-isopropyl tetralone.

JADUGOPAL DUTTA and SIPRA MUKHERJEA, Calcutta.

A synthesis of 5-methoxy-8-isopropyl-tetralone (1) has been described. p-Isopropylanisole was condensed with succinic anhydride. The resulting keto acid was reduced by Clemmensen method to yield γ-(2-methoxy-5-isopropyl-phenyl)-butyric acid which on cyclisation gave 5-methoxy-8-isopropyltetralone.

259. On the saponin and sapogenin of Albizzia odoratissima Benth seeds collected from Uttar Pradesh.

I. P. VARSHNEY and MOHD. S. Y. KHAN, Aligarh.

The seeds of Albizzia odoratissima Benth collected from the state of Uttar Pradesh yield a colourless product m.p. 227-228° which gives all the tests for saponin. On hydrolysis it yields an acid sapogenin m.p. 296-299°, acetate m.p. 265-276°, methyl ester m.p. 213-215°, acetyl methyl ester m.p. 201-202° and diacetyl bromo-lactone m.p. 180-182°. It has been identified as echinocystic acid (3β, 16α-dihydroxy-Δ^{12}-oleanene-28-oic acid or 16α-hydroxy oleanolic acid) by mixed melting point and Infra-red spectra with authentic samples of echinocystic acid and derivatives (cf. Ch. Sannié H. Lapin and I. P. Varshney, Bull. Soc. Chim. France, 1957, 1440-44). This carries glucose, xylose, arabinose and rhamnose as sugars. In contrast to this the seeds from the state of Maharashtra contain machaerinic acid (3β, 21β-dihydroxy Δ^{12}-oleanene-28-oic acid) (c.p. I. P. Varshney and Mohd. S. Y. Khan, J. Pharm, Sci., in the press).

260. On the isolation and constitution of saponin from the seed kernels of Balanites roxburghii. Planch.

I. P. VARSHNEY and K. M. SHAMSUDDIN, Aligarh.

The fruits of Balanites roxburghii, Planch obtained from U.P. gave 7·8% pericarp, 10% brown pulp, 72% seed coat and 9·6% seed kernels. The seed kernels yield 40% golden yellow oil and a colourless chromatographically and electrophoratically pure saponin m.p. 182-186°. On hydrolysis it gave a steroidal sapogenin m.p. 194-198°, acetate m.p. 201-203°. The genin has been identified as diosgenin by mixed melting point and infra-red spectra with authentic samples of diosgenin and its acetate. The earlier reported kryptogenin could not be obtained. The sugars present are glucose, xylose and rhamnose.

261. Fractionation of Beeswax and its Alcohols with urea.

T. N. MEHTA and B. N. MURTHY, Nagpur.

Bees-wax obtained locally was analysed for its constants which are as follows: Iodine value 7·60, Saponification value 97·8, Acid value 6·13 and Hydroxyl value 16·51. The wax was saponified, and the alcohols and hydrocarbons were separated from the unsaponifiable portion. The alcohols were acetylated and the acetates were fractionated with urea for finding the fatty alcohol composition which is as follows: C_{21}—0·87%, C_{26}—26·28%, C_{28}—44·04%, C_{30}—26·79%, and cyclic and branched alcohols 2·01%.

Fractionation of beeswax with urea suggests its use for deriving hard and soft varieties of the wax which are useful in the manufacture of cosmetics, candles and other products.

262. Fractionation of Fatty Acids.

T. N. MEHTA and B. N. MURTHY, Nagpur.

The fatty acids of beeswax were resolved into three groups by extraction with aqueous alcohol. The ethyl esters of these were fractionated with urea to arrive at the fatty acid composition which is as follows : Hydroxy acids 20·28% unsaturated acids 9·80% and saturated acids 69·94%. C_{16} and C_{18} acids were found to be the most predominant among the saturated acids. Fractionation of ethyl esters of the mixed acids of beeswax with aqueous 55% ethanol indicated the proportion of hydroxy and unsaturated acids to be 22·15% and 9·11% respectively.

263. The Isolation of acacic acid from the bark of Albizzia Lebbeck Benth.

H. HASAN, I. P. VARSHNEY and S. ANSAR AHMED, Aligarh.

The bark of Albizzia lebbek Benth 'Siris' yields a saponin which on hydrolysis gives a triterpenic acid sapogenin with a formula $C_{30}H_{18}O_5$ m.p. 273-74°, acetate m.p. 235-236°. It has been shown to be identical with Acacic acid, a new triterpenic acid earlier isolated from Acacia intsia Willd bark (Cf. M. O. Farooq, I. P. Varshney and Z. Naim, Arch. der Pharm., 1961, *294*, 133-137) by mixed melting point and infra-red spectra.

264. Physical and chemical properties of Shaal-seed oil.

D. MISHRA, Phulbani.

The physical and chemical properties of shaal-seed oil have been studied in details. Under physical (1) melting points, (2) specific gravity, (3) refractive index both (a) Abbe and (b) Butyro, (4) smoke point and (5) moisture and volatile matter were studied and under the chemical properties (1) acid value, (2) saponification value, (3) iodine value, (4) unsaponifiable matter, (5) Reichert Meissel value, (6) Reichert Polenske value, (7) peroxide value, (8) acetyl value, (9) Diene value, (10) Hehner value and (11) Baudouintest were carried out with a view to use this oil in animal experiment along with butter and groundnut oil.

265. Action of some oxidising agents on 2-mercapto-3-aryl quinazol-4-ones.

G. C. AMIN, (Shahad) Kalyan.

Twelve 2-mercapto-3-aryl quinazol-4-one substituted in the aryl side chain were oxidised by (i) potassium permanganate, (ii) hydrogen peroxide and (iii) chlorine gas in alkaline medium. All the three oxidising agents gave the same 3-aryl-2 :4-diketo-tetrahydro quinazoline derivative in each case.

266. Examination of fatty lipids of sugarcane wax for sterols.

S. BOSE and K. C. GUPTA, Kanpur.

Fatty matter obtained from crude sugarcane wax was dewaxed with acetone and examined for the presence of different sterols. On hydrolysis with ethanolic caustic potash it produced unsaponifiable matter (yield 45%) which on fractional crystallisation from 95% alcohol afforded crude sterols (yield 24·7%). They were found to be a tenacious mixture of sito and stigmasterols and could not be resolved into its components either by repeated fractional crystallisation or by chromatography. By applying Windaus and Hauth's procedure the crude sterol mixture was, however, separated into crystalline tetrabromostigmasterol acetate and soluble dibromositosterol acetate fractions. By debromination and deacetylation tetrabromostigma sterol acetate, m.p. 209-10° was converted into stigmasterol, m.p. 169-70° $[\alpha]_D^{28} = -46°$ (chloroform). Dibromositosterol acetate, upon debromination and subsequent chromatography over activated alumina, furnished pure acetyl compound, m.p. 127-28° $[\alpha]_D^{28} = -40°$ (chloroform). It was deacetylated to yield a crystalline substance which after several times crystallisation from methanol showed m.p. 139-140°, $[\alpha]_D^{28} = -37°$ (chloroform) characteristic of β-sitosterol. The yield of β-sitosterol and stigmasterol from unsaponifiable fraction was found to be 5·6% and 13·37% respectively.

Fatty matter, when subjected to alcohol fractionation procedure directly, produced crude sterol in a yield of 8·01%. By adopting the above procedure it was separated into stigmasterol and β-sitosterol, their yields being 0·69 and 2·66%, respectively. During alcohol fractionation of fatty matter, a low melting solid (m.p. 70-80°) was obtained in a very small amount. Purification of the compound by column chromatography raised its m.p. to 80-83°. Upon acetylation it produced a monoacetyl derivative, m.p. 64-65°. A comparison of the m.p. of the original compound and its acetyl derivative with those of the existing higher alcohols establishes its identity with n-octacosanol.

267. The structure of Salmalia malabaricum (Syn. Bombax malabaricum) gum part I. Nature of sugars present.

S. BOSE and A. S. DUTTA, Kanpur.

Crude *Salmalia malabaricum* gum, commonly known as "Semul" gum has been purified by precipitation from an acidified aqueous solution by addition of absolute alcohol. Pure gum is insoluble in water and has an ash content, 0·426; pentosan, 13·9 and pentoses, 15·89 per cent. Complete acid hydrolysis of the gum furnished neutral sugar fraction (A) and barium salt of uronic acid (B). Paper chrmotographic examination of (A), using n-butanol-ethanol-water (5 :1 :4) as irrigating solvent and silver nitrate spray reagent, indicated the presence of arabinose, galactose and probably rhamnose. By cellulose column chromatography, (A) was resolved into two homogenous crystalline components which were identified as L-arabinose and D-galactose from a measurement of specific rotation and preparation of their characteristic crystalline derivatives. Quantitative hydrolysis showed that D-galactose and L-arabinose were present in the gum in 2 :1 proportion. Uronic acid liberated from fraction (B) was identified as gelactouronic acid from (a) paper chromatographic examination [Irrigating solvent : n-Butanol-acetic acid-water (4 :1 :5); sprayreagent, p-anisidine phosphate], (b) positive basic lead acetate test and (v) oxidation to mucic acid, m.p. 212°. For further confirmation about its nature, methylester methyl glycoside of the uronic acid (B) was subjected to sodium borohydride reduction and acid hydrolysis when D-galactose was obtained as the neutral sugar. During acid hydrolysis or when the suspension of gum in water is heated, arabinose is released first. The easy elimination of the pentose indicates its presence in the furanose from within the gum structure.

268. The hemicellulose from bagassee. Part II. Isolation of a xylan and dl-xyloketose.

B. C. BANERJEE, S. BOSE and S. MUKHERJEE, Kanpur.

An alkaline solution of bagassee hemicellulose, upon treatment with Fehling's solution, gave a dark blue precipitate of copper complex which after decomposition with cold hydrochloric acid was diluted with a large excess of acetone. The precipitated polysaccharide was washed with water and resubjected to the above procedure when a pure xylan fraction (sulphated ash 0·33%, Pentosans 98·6%) was obtained. On complete hydrolysis it gave rise to a single sugar, namely, Xylose. By hypoiodite oxidation method the degree of polymerisation and the molecular weight of the Xylan has been estimated to be 65-70 and 9000 respectively.

Bagasse hemicellulose, upon acid hydrolysis, furnishes an unknown sugar in a very small amount along with D-glucose, L-arabinose and D-xylose. The Rf value of the sugar indicates that it might be either 3-O-methyl glucose or a keto-pentose. The former possibility is ruled out from the behaviour of the sugar when its paper chromatogram is sprayed with specific ketonic reagents like p-anisidine phosphate, Sodium metaperiodate, Benzidine B-Benzidine-A and Resorcinol-ethanolic hydrogen chloride. In every case, characteristic colour corresponding to keto-pentose is developed. By cellulose column chromatography the unknown sugar has been obtained in a homogenous state in the form of a syrup. It produces a crystalline osazone, m.p. 202-204°. The high m.p. indicated that it might be DL-Xylosazone (Reported m.p. in the literature is 207°). Further identity of the sugar osazone was established by conducting its paper chromatography on a borax buffered filter paper, using 75% dioxane-hexane-water-benzene (55 : 50 : 25 : 20; upper layer) as the irrigating solvent, along with authentic samples of L-arabinosazone and D-xylosazone. The unknown osazone moved at the same rate as xylosazone, thereby establishing that the corresponding sugar must be DL-xyloketose. That this sugar is not an artifact is proved from the fact that neither pure xylose nor xylan, isolated from the hemicellulose, gives rise to it when warmed with dilute acid. Therefore it is concluded that Dl-xyloketose is present as a part of the hemicellulose structure.

269. The structure of Chloroxylon swietenia gum. Part I. Nature of sugars released on graded hydrolysis.

S. BOSE, N. N. MODY and S. MUKHERJEE, Kanpur.

Chloroxylon swietenia gum, commonly known as "Satinwood gum", is almost insoluble in water in the crude state. Once purified by precipitation process, the gum becomes water soluble. Ion-exchange resin treatment of the aqueous solution of the gum and subsequent precipitation with acetone resulted in the production of the pure gum acid in the form of a white powder $[\alpha]_D^{29} = -20{\cdot}96°$. It has an equivalent weight 1200, ash, 0·43, methoxyl, 4·43; pentosan 30·38 and pentoses (calculated from pentosans), 34·53 per cent. Autohydrolysis of the gum produces a degraded gum and sugar mixture. Chromatography of the sugar mixture on filter papers and also on cellulose column definitely settled the presence of L-arabinose and D-galactose which were identified from their m.ps., specific rotation and the m.ps. of their characteristic crystalline derivatives. Besides them, the presence of two other sugars (Rg. 0·30 and 0·26 respectively) in very small amount have been noted. They have been provisionally identified as rhamnose and fucose. In this experiment, the amount of arabinose was found to be higher than that of galactose. Mild hydrolysis of the degraded gum resulted in the production of aldobionic acids and a sugar mixture consisting of more of galactose and less of arabinose. Paper chromatography and subsequent acid hydrolysis with normal sulphuric acid revealed the mixed character of aldobiuronic acids which gave rise to uronic acid mixture and galactose. In the hydrolysate, traces of arabinose were also noticed. Using different irrigating solvents in the process of paper chromatography, one of constituents of the uronic acid mixture has been identified as D-galactouronic acid. Conversion of the Uronic acids into neutral sugars yielded a mixture, in which the presence of D-galactose has been established.

270. Reactivity of Pyridine: Part IV.

B. J. GHIYA and M. G. MARATHEY, Amravati.

In connection of our study of the reactivity of pyridine, a newly discovered property of pyridine in this laboratory, it has been reported in our earlier communications (J. Sci. industr. Res., *20B,* (1961),—Part I and II) that pyridine reacts with chalkone dibromides and the mechanism of the reaction involves three major steps; (i) debromination, (ii) unclear substitution and (iii) oxidative cyclization. The reaction depends upon the structure of the chalkone as a whole. 2′-Hydroxy-5′-methyl-4-methoxy chalkone dibromide with pyridine in presence of sodium thiosulphate was refluxed for 15 min. 2′-Hydroxy-5′-methyl-4-methoxy chalkone was obtained. 2′-Acetoxy-5′-methyl-4-methoxy chalkone dibromide on treatment with pyridine gave 2-acetoxy 5′-methyl-4-methoxy chalkone. This mechanism suggested agrees well as the predicated intermediates have been isolated. The reactivity of pyridine was also studied on the substances other than chalkone dibromides on similar ground.

271. Bromination of Benzo-pyrones.

K. B. DOIFODE and M. G. MARATHEY, Amaravati.

Bromination of 4-methyl-5-hydroxy-6-acetyl coumarin, I, m.p. 164°, with one mole of bromine in AcOH was reported to give two isomeric monobromo compounds. In the present work it was found that only one monobromo compound, II, m.p. 226°, was obtained and the reported second compound was a mixture of II and I.

Action of 10% Na_2CO_3 on II gave a compound, III, m.p. 81°, as reported earlier. 3-Methyl-4-hydroxy-5-acetyl coumarone, m.p. 71°, IV, has been synthesised earlier by Limaye and others. The compound, III, which should in ordinary course be IV is found to be different and the structure is being investigated.

272. Reactivity of Pyridine: Part V.

(Miss) KUNDA R. KUTUMBE and M. G. MARATHEY, Amravati.

Pyridine reacts with chalkone dibromides giving bromo flavones by abstracting bromine, forming Py. Br. Br. complex and nuclear bromination and oxidative cyclisation, the final product obtained being dependent on the structure of the molecule. The B-ethoxy derivative when treated similarly is found to remain unchanged. Even the B-hydroxy derivative, which is so reactive as to give a flavonol on treatment with alkali, remains unchanged when treated with pyridine. These reactions indicate that pyridine does not always behave as a normal base.

4′-Methoxy-6-methyl benzylidenecoumaranone dibromide when treated with pyridine has been found to undergo debromination giving back the corresponding benzylidene coumaranone.

273. Changes in the Component Fatty Acids of Mango-seed Oil During Development.

S. P. PATHAK and A. K. VASISHTHA, Varanasi.

General characteristics and fatty acid composition of mango-seed oil was studied at different stages of development. It was found that as the age of development is advanced the fat content shows a gradual rise and the free fatty acid goes on decreasing. The increase in unsaturation after the commencement of rainy season shows a marked effect of environmental conditions in which the development is taking place.

The study is unique of its kind on a non-drying type of oil and confirms that in seeds of same species, the relative proportions of oleic and linoleic acids may vary considerably and such variation may be conditioned by the temperature of the locality where the seed ripens, and strongly supports the view that the typical unsaturated acids are built up by different mechanism to that which operates in the biosynthesis of the saturated acids. A more detailed work of this type on a non-drying oil is also suggested.

274. Component Fatty Acids of an Indian Fresh-water Fish Labeo calbasu Oil.

S. P. PATHAK and B. C. L. AGRAWAL, Varanasi.

In the present work the fatty acid compositions of body and visceral oils from fresh water fish *Labeo calbasu* have been studied. The body and the visceral oils were hydrolysed and the recovered mixed fatty acids were resolved into groups of simpler mixture of acids differing in unsaturation by the Lithium salt-acetone method followed by the Lead salt-ethanol method. Each group was methylated and the esters were fractionated separately under high vacuum using electrically heated and packed column. The fatty acid compositions were calculated from the saponification equivalents and iodine values of each of the sub-fractions. The body fat contains 35·74% saturated acids (myristic 1·00%, palmitic 22·11%, stearic 11·32% and arachidic 1·31%) and 64·26% unsaturated acids (C_{14} 0·95%, C_{16} 12·58%, C_{18} 39·92%, C_{20} 8·19% and C_{22} 2·62%). The visceral fat contains 38·82% saturated acids (myristic 2·07%, palmitic 24·95%, stearic 10·79% and arachidic 1·01%) and 61·18% unsaturated acids (C_{14} 0·65%, C_{16} 13·00%, C_{18} 36·38%, C_{20} 9·16% and C_{22} 1·99%).

The mean unsaturation of acids are −2·0, −3·1, −4·2, −5·7 and −7·0 of C_{14}, C_{16}, C_{18}, C_{20} and C_{22} acids respectively in the body fat and −2·0, −2·2, −2·6, −5·3 and −8·0 of C_{14}, C_{16}, C_{18}, C_{20} and C_{22} acids respectively in the visceral fat.

275. Studies on sardine oil—extraction from press liquor and its stabilization.

N. L. LAHIRY, Mysore.

Sardine oil, as extracted by indigenous method, is of poor quality. According to Vasavan and co-workers, at least about 560,000 lbs. of sardine oil was extracted in Malabar coast alone during 1957-58.

A method for extraction of good quality sardine oil from the press-liquor from body and from head and entrails have been described. The oils thus extracted were found to give no foul smell on storage. The oil samples were studied with respect to refractive index, optical densities, colour, iodine value, saponification value, non-saponifiable matter, free fatty acids, peroxide value. Stability study by weighing method for a period of 815 hours (34 days) with different antioxidants, namely, prophyl gallate, BHA, BHT (with and without citric acid) and hydroquinone, indicating hydroquinone at 0·50% level, was the most effective antioxidant for sardine oil, next in order BHA, BHT and PG. Final free fatty acid content, peroxide value and aldehyde value, also corroborated this.

276. Studies on the chemical qualities and storage behaviour of sun-dried salted fish as available in market.

N. L. LAHIRY, Mysore.

Dry-curing of fish is an established trade practice in India. Yet, the products obtained are without any standard. Also, these products cannot be stored for long, and thus, the very purpose of curing is often lost.

The present investigation was undertaken to determine the chemical and the organoleptic qualities of fifteen different samples of dry-cured fish as available in the market in order to assess the variations in the chemical parameters and also to determine their culinary quality.

Simultaneously, storage behaviour of six market samples of dry-cured fish under control humidity conditions and also under sealed conditions, were studied, with a view to determine their storage life and associated problems.

Results indicated that the products varied widely in their chemical and organoleptic properties. Storage behaviour under control humidity conditions at room temperature, indicated that product became inedible by 32-33 days at 75-100% R.H., and by 85-90 days at 63% R.H. In sealed containers at room temperature, products studied became inedible in 45-65 days period.

277 Studies in the cycloheptane series Part VII. The syntheses of benzcycloheptane-3-spiro-2′-methyl-cyclopentane and 8-methylbenzcycloheptane-3-spiro-2′-methylcyclopentane.

K. C. MATHUR and G. S. SAHARIA, Delhi.

The present work describes the syntheses of benzcycloheptane-3-*spiro*-2′methylcyclopentane and 8-methylbenzcycloheptane-3-*spiro*-2′-methylcyclopentane. 3-Methylcyclopentanone was condensed with ethyl cyanoacetate in presence of alcoholic ammonia to give the corresponding dicyanoimide, which on hydrolysis furnished 3-methylcyclopentane-1 :1-diacetic acid. Its anhydride on Friedel and Crafts reaction with benzene and toluene gave the corresponding keto-acids. It may be mentioned here that of the expected two isomeric keto acids only one was isolated inspite of repeated trials. These keto acids on reduction by Wolff-Kishner's method and cyclisation by internal Friedel and Crafts reaction yielded the cyclic ketones. Final reduction of these ketones to benzcycloheptane-3-*spiro*-2′-methylcyclopentane and 8-methylbenzcycloheptane-3-*spiro*-2′-methylcyclopentane was carried out by Wolff-Kishner's method.

278. Studies in the cycloheptane series part VI. The syntheses of benz-3-methyl-3-ethylcycloheptane and 8-methylbenz-3-methyl-3-ethylcycloheptane.

K. C. MATHUR and G. S. SAHARIA, Delhi.

In continuation of our earlier work, the syntheses of benz-3-methyl-3-ethylcycloheptane and 8-methylbenz-3-methyl-3-ethylcycloheptane have now been carried out. The starting material β-methyl-β-ethylglutaric acid was prepared from methyl ethyl ketone through Guareschi condensation. The anhydride of this acid was then condensed with benzene and toluene under the conditions of Friedel and Crafts reaction, when the corresponding γ-aroyl butyric acids were obtained. These acids when reduced by Clemmensen's method gave δ-arylvaleric acids which were cyclised through their acid chlorides and the cyclic ketones thus obtained on Clemmensen's reduction yielded the hydrocarbons, benz-3-methyl-3-ethylcycloheptane and 8-methylbenz-3-methyl-3-ethylcycloheptane.

279. Studies on C-Methyl-γ-Benzopyrone system-orientation in isoflavone series.

W. RAHMAN and KH. TAKRIMULLAH NASIM, Aligarh.

The ethoxalylation of 4′-and 2′-methyl ethers of 2,4,6-trihydroxy-3-methyl deoxybenzoin has resulted in the formation of an isomeric mixture of isoflavones of 5,6,7-and 5,7,8-orientations. The orientation of each isomer has been authenticated by comparison with synthetic standards. The investigation of the condensation of 2,4,6-trihydroxy-3-methyl deoxybenzoin with acetyl chloride and pyridine at 0° (followed by refluxing with aqueous sodium carbonate) and acetic anhydride and sodium acetate at high temperature has also given rise to isomeric mixtures of 2-methyl isoflavones of the same orientations. The dual course of very facile Baker-Venkataraman transformation followed by isoflavone ring closure has been suggested for the formation of isomeric mixture in each case.

280. Addition of Dienophil to Undecylenic acid.

M. MUKHERJEE and A. N. SAHA, Calcutta.

Reaction between Undecylenic acid and $CH_2=CH\text{-}CHO$ was effected at different temperatures namely 160, 180, 200°C with yields of products 53·8, 60·0, 65·0, respectively. The reaction time in each case is four hours. The product is a dark brown coloured viscous liquid. No stereomeric forms could be isolated.

281. Naturally occuring Antidiabetic Principles.

H. D. BRAHMACHARI and K. T. AUGUSTI, Pilani.

A large number of indigenous plants of India have been claimed to contain antidiabetic principles by various workers. Some of these plants have even been reported to contain orally effective substances. An orally effective hypoglycemic principle was extracted by the authors from the common onion bulbs and reported last year (Proc. Ind. Sci. Cong. III, 1961). A systematic examination of all the plants claimed to have antidiabetic properties have been undertaken in this laboratory and a preliminary report on the results obtained so far is presented here.

The roots, leaves, barks or fruits of the plants concerned were crushed in a ball mill after thorough drying and extracted with the different solvents. These extracts were carefully dried under vacuum and the solid residues fed to groups of normal fasting (18 hrs.) rabbits in fixed doses and the hypoglycemic activity, if any, studied for a period of 3-4 hrs., and compared to that produced in a set of control animals fed with a standard dose of tolbutamide.

Alcoholic extracts of the barks of Ficus bengalensis and Ficus religiosa and that of the seeds of Eugenia jambolana were found to be orally effective; while watery, alcoholic and ether extracts of Vinca rosea (leaves), Tinospora Cordifolia (stem), Cassia auriculata (flowers and seeds), Melia azadirachta (leaves), Cocus nucifera (flowers), Cassia glauca (leaves), and Premna integrifolia (roots) were found to be completely ineffective orally.

282. Large scale Extraction of Psoralen-Isopsoralen from Psoralea Corylifolia (Babchi).

S. J. DAS GUPTA, Calcutta.

Psoralea Corylifolia (Babchi) is a very ancient remedy for leucoderma. It has been tried extremelv not only by the practitioners of Hindu medicine but also by followers of Western system. Recent investigations have shown that seeds of Psoralea Corylifolia contain two furano coumarin compounds—Psoralen (m.p. 163°) and Iso-psoralen (m.p. 142°) in small quantities, which are useful in the treatment of certain types of leucoderma. Generally the two compounds are isolated in the form of a mixture. A method for large-scale extraction of Psoralen-Isopsoralen from seeds of Psoralea Corylifolia for commercial purposes has been described in the present paper.

500 lbs. of fresh and dried seeds were powdered to 30 mesh in a pulveriser and soaked in water. The powder after being dried was introduced into a soxhlet type extractor made of copper and steam jacketted. 160 gallons of solvent oil was used for extraction. About 90% of the solvent was recovered. The crude psoralen-Isopsoralen which was obtained from the residue was purified by treatment with alcohol and activated charcoal. Yield—2·7 to 0·8%.

283. Coal gas as a substitute for synthetic gas in the Fischer-Tropsch reactions, Part IV. "Variation of reaction characteristics with time".

G. C. BASAK and N. C. NIYOGI, Howrah.

The work embodied in the paper is a continuation of the investigation undertaken for the past few years to study the reaction characteristics of the Fischer-Tropsch type synthesis with coal gas on a Cobalt-base catalyst. The present investigation sought to test the activity of the catalyst and study the nature of reaction products by using the catalyst over extended periods lasting 100 hours at a time at a constant temperature of 180°C and continuing the same study by reactivating the catalyst every 100 hours. The results indicate that the activity of catalyst and conversion into hydrocarbon products reach maximum values within 12 hours of the start of the reaction after which these decline at more or less steady rates. The activity is restored by reactivating the catalyst by hydrogenation for one hour at 400°C. The significant observation was made that the catalyst showed increased activity and better capacity for producing larger amounts of hydrocarbons other than CH_4, when the same catalyst was used over and over again after reactivation each time, than a freshly once-reduced catalyst.

284. Possible Antiamoebic Agents. Part XVI.

A. B. SEN and S. K. GUPTA, Lucknow.

Twenty five new N-substituted-2-amino-pyridines and pyrimidines have been prepared with a view to test their antiamoebic activity (cf. Neal & Vincent, Brit. J. Pharm., 1955, *10*, 434; Brown et. al., J. Chem. Soc., 1950, 1945; Waletzky et. al., Science, 1950, *111*, 720).

The N-substituted-2-amino-pyridines were obtained by condensing 2-chloro-5-nitro-pyridine with appropriate amines; while N-substituted-2-amino-pyrimidines were obtained by refluxing 2-methylthio-pyrimidines with appropriate amines at 170°C.

285. Coumarino-α-pyrones and Furocoumarins.

K. N. TRIVEDI and SURESH SETHNA, Baroda.

7-Hydroxy-3 : 4-dimethylcoumarin when condensed with malic acid gave 3 : 4-dimethylcoumarino-7 : 8-α-pyrone. The structure was proved by direct comparison with the product obtained on Perkin acetylation of 7-hydroxy-8-formyl-3 : 4-dimethylcoumarin. The structure of 7-hydroxy-8-formyl-3 : 4-dimethylcoumarin was proved by converting it to the known 7 : 8-dihydroxy-3 : 4-dimethylcoumarin by Dakin Oxidation. 7, 8-Dihydroxy-3 : 4-dimethylcoumarin and 5-hydroxy-3 : 4 : 7-trimethylcoumarin on similar condensation with malic acid gave 8-hydroxy-3 : 4-dimethylcoumarino-7 : 6-α-pyrone and 3 : 4 : 7-trimethylcoumarino-5 : 6-α-pyrone respectively. 7-Hydroxy-4 : 8-dimethylcoumarin and 7-hydroxy-4 : 6-dimethylcoumarin did not condense with malic acid.

7-Hydroxy-3-bromo-4-methylcoumarin when condensed with malic acid gave 3-bromo-4-methylcoumarino-7 : 8-α-pyrone. It was also obtained by the bromination of 4-methylcoumarino-7, 8-α-pyrone. This compound, on hydrolysis with alcoholic potassium hydroxide solution, gave furo-3′-methyl-4′, 5′, 5, 6-coumarin-2′-carboxylic acid which afforded furo-3′-methyl-4′,-5′,-5, 6-coumarin on decarboxylation with copper and quinoline. 7 : 8-Dihydroxy-3-bromo-4-methylcoumarin on similar condensation with malic acid gave 8-hydroxy-3-bromo-4-methylcoumarino 7, 6-α-pyrone. Attempts to synthesize 3-methylxanthotoxol and 3-methylxanthotoxin by hydrolysizing the bromo compound by alcoholic potassium hydroxide solution, or sodium carbonate solution met with failure. 7-Hydroxy-3, 8-dibromo-4-methylcoumarin and 7-hydroxy-3, 61dibromo-4-methylcoumarin did not condense with madic acid.

286. Chloromethylation of some chromones and flavones.

M. V. SHAH and SURESH SETHNA, Baroda.

2-Methylchromone and flavone on chloromethylation even with excess of paraformaldehyde gave only the 3-chloromethyl derivatives. These were reduced to the corresponding 3-methyl derivatives and compared with the authentic specimens. 7-Methoxy-2-methylchromone and 7-methoflavone on chloromethylation gave the 8-chloromethyl derivatives. On reduction they gave the corresponding methyl derivatives which were found to be identical with the methyl ethers of the products obtained on condensation of 2-methyresorcinol with ethyl acetoacetate and ethyl benzoylacetate respectively in boiling diphenyl ether. On further chloromethylation the 3, 8-dichloromethyl derivatives were obtained which on reduction gave 7-methoxy-2, 3, 8-trimethylchromone and 7-methoxy-3, 8-dimethylflavone as seen by direct comparison with authentic specimens.

287. Synthesis of some bichromonyls, biflavonyls and 7-methoxy-8-phenyl-2-methyl-chromone and -flavone.

M. V. SHAH, Baroda.

7-Methoxy-6-iodo- and 7-methoxy-8-iodo-2-methylchromone and 7-methoxy-8-iodoflavone have been converted into the corresponding bichromonyl and biflavonyl derivatives by the Ullmann reaction. 7-Methoxy-6-iodo-3-benzoylflavone on a similar Ullmann reaction give the 6, 6′-biflavonyl derivative.

7-Methoxy-8-iodo-2-methylchromone and 7-methoxy-8-iodoflavone on crossed Ullmann reaction with iodobenzene gave the corresponding 8-phenyl derivatives.

The above bichromonyls, biflavonyl and 8-phenyl derivatives except 7, 7′-dimethoxy-3, 3′-dibenzoyl-6, 6′-biflavonyl were demethylated to the corresponding hydroxy compounds.

288. Mannich reaction on some coumarin derivatives.

M. G. PATEL and SURESH SETHNA, Baroda.

7-Hydroxycoumarin (I) on reaction with one mole of paraformaldehyde and dimethylamine (A) gave the 8-dimethyl aminomethyl derivative. Its structure was proved by converting it into the known 8-formyl derivative by heating with hexamine. (I) with benzylamine (B) gave mainly 2′ H-3′-benzyl-3′, 4′-dihydro-1′, 3′-oxazino-5′, 6′, 8, 7-coumarin with a small quantity of 7-hydroxy-8-benzylaminomethyl derivative and with aniline (C) it gave mainly 2′ H-3′-phenyl-3′, 4′-dihydro-1′, 3′-oxazino, 5′, 6′, 8, 7-coumarin with a small amount of 7-hydroxy-8-anilinomethyl-coumarin. The oxazino derivatives were hydrolysed with alcoholic hydrochloric acid to the 8-benzylaminomethyl and 8-anilinomethyl derivatives which were converted by treating with hexamine into the 8-formyl derivative.

6-Hydroxycoumarin on similar reaction with (A) gave the 5-dimethylaminomethyl derivative which was converted into the known 5-formyl derivative. With (B) and (C) only the oxazino derivatives 2′ H-3′-benzyl-3′, 4′-dihydro-1′, 3′-oxazino-5′, 6′, 5, 6-coumarin and 2′ H-3′-phenyl-3′, 4′-dihydro-1′, 3′-oxazino-5′, 6′, 5, 6-coumarin were obtained. These were converted into 5-benzylaminomethyl and 5-anilinomethyl derivatives respectively which with hezamine gave the 5-formyl derivative.

Ethyl 7-hydroxycoumarin-3-carboxylate with formalin and with (A), (B) and (C) gave the 8-dimethylaminomethyl derivative, 2′ H-3′-benzyl-3′, 4″-dihydro-3-carboethoxy-1′, 3′-oxazino-5′, 6′, 8, 7-coumarin, and 2′ H-3′ phenyl-3′, 4′-dihydro-3-carboethoxy-1′, 3′-oxazino-5′, 6′, 8, 7-coumarin respectively.

The first two products were brominated and the bromo derivatives were found to be identical with the products obtained on reacting ethyl 7-hydroxy-6-bromocoumarin-3-carboxylate with formalin and (A) and (B) respectively.

289. "Studies in the chemistry of the non-Fatty matter obtained from the seeds of Melia azedarach, Linn."

R. V. PATWARDHAN, V. G. SONAR and V. A. PATWARDHAN, Sangli.

Melia azedarach, Linn., known as the Persian lilac in English and as 'Bakannimb' or 'Himdruma' in Marathi, is a deciduous tree belonging to the botanical Family—Meliaceae, and is long known to have high medicinal value. The seeds used have been obtained from a tree in Sangli.

The non-fatty matter in the seeds was obtained after complete extraction of the fatty matter from the crushed seeds by means of diethyl ether. On analysis of the non-fatty matter by A.O.A.C. methods, the following percentage composition was obtained :—Moisture 11·65, Mineral matter (ash) 5·3, Sand and siliceous matter 0·062, crude Protein 34·9, crude Fibre 8·12 and digestible carbohydrates 40·03—(Starch 7·1 and Sugars 0·9). Ash contained iron, calcium, magnesium, potassium, sulphate, carbonate, phosphate and silicate.

The identification of the amino-acids obtained on hydrolysis of the non-fatty matter has been done by the application of circular paper chromatography. The chromatogram has shown the presence of leucine, phenylalanine, valine, tyrosine, proline, alanine, glutamic acid, serine, arginine, histidine and lysine.

The non-fatty matter was extracted with different solvents and the extracts were studied. The percentages of the different extracts were as follows : Ethyl alcohol 2·15; Ethyl acetate 1·55; Chloroform 1·36 and Acetone 1·3.

The ethyl alcohol extract showed the presence of carbohydrates and the absence of tannins. The ethyl acetate extract showed the presence of saponins. Prollius test for alkaloidal matter indicated its presence in traces.

290. "Composition of the fatty acids obtained from the fatty oil of the seeds of Melia azedarach, Linn."

R. V. PATWARDHAN, V. G. SONAR and V. A. PATWARDHAN, Sangli.

Melia aredarach, Linn. (English : Persian lilac,—Marathi : Baykan-nimb or Himdruma) is a deciduous tree belonging to the botanical family, Maliaceae. It is long known to have high medicinal value. The seeds obtained from a tree in Sangli have been used for the extraction of the fatty oil. The pale yellow oil obtained to the extent of 44 per cent., was saponified and the mixed fatty acids were extracted after separation of the unsaponifiable matter. By using different methods the mixed fatty acids obtained were found to have the following percentages of oleic acid, linoleic acid and saturated acids :—

Method	Oleic acid	Linoleic acid	Saturated acids
Bromination	44·78	48·92	6·3
Urea adduct	42·17	52·56	5·3
Thiocyanogen	42·96	54·24	2·8

The composition of the saturated acids calculated from the equivalent weight is palmitic acid 3·7% and stearic acid 2·6%. The composition of the mixed fatty acids by spectrophotometric, chromatographic and other methods is being studied.

291. A study on the modification of rosin and film forming properties of the products.

SANT KUMAR and A. C. GUPTA, Kanpur.

Oleoresionous varnishes have been prepared from limed rosin, Zinc-calcium resinate, Estergum and Pentaerythritol esters and comparative film forming properties have been evaluated. Zinc calcium resinate had the highest softening point (118°C) and varnishes prepared from this product as well as from Pentaerythritol modified product gave better performance in respect of hardness test as compared to the estergum and limed rosin. Outdoor exposure tests showed the complete failure of the film of the limed rosin and zinc calcium rosinate. Pentaerythritol ester showed some durability in comparison to others.

292. Synthetic studies in the indole field. Part I: Synthesis of 7-Nitrotryptophan.

S. P. HIREMATH and S. SIDDAPPA, Dharwar.

The synthesis of 7-nitrotryptophan by two different routes is described in the paper. 7-Nitroindole prepared from ethyl pyruvate o-nitrophenylhydrazone through a Fischer cyclisation with polyphosphoric acid was converted to 3-diethylaminomethyyl-7-nitroindole, m.p. 79-80°, and condensed with acetamidomalonic ester. The resulting ethyl α-acetimido-α-carbethoxy-β-(7-nitro-3-indolyl)-propionate (A) m.p. 202-3°, on hydrolysis, decarboxylation and deacetylation gave 7-nitrotryptophan, m.p. 320°. The Warner and Moe's method for the synthesis of the above amino acid was found to be successful and gave better yields. γ-Acetamido-γγ-dicarbethoxy-n-butyraldehyde o-nitrophenylhydrazine, m.p. 40°, was prepared from acrolein, acetamidomalonic ester and o-nitrophenylhydrazine and cyclised with polyphosphoric acid in good yields to obtain the intermediate (A) required for the preparation of 7-nitrotryptophan, which is of interest as a bacterial inhibitor.

293. Behaviour of 5-Pyrazolones with Benzaldehyde and study of the infra-red spectra of the condensation products.

D. C. PATI, A. S. MITRA and M. K. ROUT, Cuttack.

5-Pyrazolones with only one reactive hyydrogen in the 4-position have been reacted with benzaldehyde and bis-hetero-cyclic compounds have been obtained. I.R. absorption spectra of the condensation products have been studied.

294. Infra-red spectra of some heterocyclic keto-methylene compounds Part I, amide carbonyl bands, enolic bands and aromatic bands.

A. S. MITTRA and M. K. ROUT, Cuttack.

In the present investigation, a number of keto-methylene compounds have been prepared and their I.R. spectra have been studied. The following structural changes have been investigated : (1) effect of conjugation on the amid > C=O band by formation of styryl compounds, (2) influence of arylation or alkylation of the > NH hydrogen on the amide carbonyl band, (3) introduction of styryl group into the compounds and its characteristic frequencies, (4) effect on the enolic character of the amide > C=O on formation of styryl compounds.

295. Merocyanines and unsymmetrical cyanines derived from diphenyl thiothiazoline.

B. K. SABATA, G. GHOSH and M. K. ROUT, Cuttack.

The preparatons of some merocyanines and unsymmetrical cyanines derived from diphenyl thiothiazoline are described. Comparison of their absorption maxima with those derived from 4-aryl-2-methyl thiazole indicates that these may be regarded as $n=0$ type merocyanines and unsymmetrical cyanines corresponding to $n=1$, 2 & 3 type merocyanines and ussymmetrical cyanines derived from 4-aryl-2-methyl-thiazole.

296. Merocyanines derived from substituted benzimidazoles.

P. K. MISRA, B. K. SABAT and M. K. ROUT, Cuttack.

The present work describes the preparation of substituted benzimidazole and preparation of merocarbo- and merodicarbo cyanines derived from substituted -2-methyl benzimidazoles and substituted rhodanines.

The merocarbocyanines were prepared by condensing 2-methyl benzimidazole methiodides with 5-ethoxy methylene-3-phenyl rhodanine in presence of acetic anhydride and triethylamine. The merodicarbocyanines were prepared by condensing 2-methyl benzimidazole methiodides with 5-(3-acetanilido allylidine) 3-phenyl rhodanine in presence of acetic anhydride and triethylamine.

297. Unsymmetrical cyanines derived from thiazoles and thiadiazoles.

P. B. TRIPATHY and M. K. ROUT, Cuttack.

Two series of unsymmetrical cyanines are described. The first series is derived from thiadiazole as the fixed basic nucleus and a number of basic nuclei as the variable component. In the second series, 4-p-bromophenyl thiazole is used as the fixed basic nucleus and two other nuclei as the variable basic component.

The absorption maxima of the above dyes have been determined and from the absorption data, the corresponding deviations have been calculated.

The relationship between deviation and relative basicity has been clearly brought by considering the energy level diagrams of both symmetrical and unsymmetrical cyanines.

298. Preparation of N-2 (4-aryl thiazolyl) benzamidines for use as antitubercular compounds.

R. K. SATAPATHY, B. DASH and M. K. ROUT, Cuttack.

Several N-2-(4-aryl thiazolyl) benzamidines have been prepared by treating equimolecular quantities of different 4-aryl-2-amino thiazoles and benzo nitrile with an equivalent of sodium. These compounds are expected to possess remarkable activity against Mycobactorium tuberculosis because of their similarity to several antitubercular compounds and of their basic nature, a condition conducive to greater antitubercular activity (Robinson, J. Chem. Soc., 1940, 505).

BIOCHEMISTRY

299. Rapid determination of the reducing sugars by modified Bertrand method.

M. V. HEGDE and N. R. KALE, Poona.

The method consists of heating varying amounts of reducing sugar with excess of copper reagent in a series of special centrifuge-tubes at 98°C for fifteen minutes. The precipitate of Cu_2O formed is collected by sedimentation. Quantitative sedimentation is achieved by the addition of dilute solution of "Tween 60" as a wetting agent. After thorough washing, Cu_2O ppt is dissolved in acetic acid and copper is determined iodometrically.

The method is found to be applicable for the estimation of glucose, lactose, maltose, invert sugar galactose, mannose, arabinose and xylose, showing a linear relationship between the reducing sugar and Cu_2O ppt over a range of 2 to 15 mgms. of sugars.

300. Studies on iodine binding capacities of purified amylose and amylopectin by potentiometric method.

MISS SAROJ P. GUPTE and N. R. KALE, Poona.

Purified amylose and amylopectin were obtained by fractionating potato starch with ethanol in presence of urea. Iodine binding capacities of these products were critically determined by Rundel's potentiometric method. The values obtained for amylose and amylopectin are 19·5% and 0·27% in contrast with 19·5% and 0·45% respectively, reported by previous workers. The results indicate that the products isolated by this method are pure and amylopectin is free from traces of amylose.

301. Purification of Acid Phosphatase from Agave (cantala).

A. S. SANE and N. R. KALE, Poona.

Soluble acid phosphatase is isolated from saline extract of Agave (Cantala). Active enzyme is quantitatively precipitated on addition of acetone 50 per cent (v/v), at 0°C. Further purification with ammonium sulphate (2·2 M) gave a product of 20 fold purification with a yield of 45%. Preliminary results indicate that enzyme is a monoesterase with optimum PH 4·6 and is remarkably stable up to 60°C.

302. "Turbidimetric estimation of serum globulins by cadmium sulphate reagent."

B. P. GHOSH, Calcutta.

1. Attempt has been made to develop a simple turbidimetric method for testing liver function by employing cadmium sulphate reagent prepared by dissolving 400 mg. cadmium sulphate in 1000 c.c. Barbitone buffer pH. 7·5 and estimating the turbidity in a Klett—Summerson photo-electric colorimeter with Filter 64.
2. The albumin/globulin ratio in serum seems to correlate with the turbidity reading with this reagent.
3. The Gamma globulin in serum increases the turbidity value.
4. A high turbidity reading in presence of a normal albumin/globulin ratio may be the indication of elevation of Alpha$_1$, Alpha$_2$ or Beta/globulin in serum.
5. A poor response is obtained with this reagent in cases where the levels of globulin fractions are either normal or low.

303. Liver ketogenesis V: In-vitro acetoacetate production and utilization in rats fed high fat-high protein diet.

J. M. KHANADE and M. C. NATH, Nagpur.

These results, in general, indicate that the metabolism of tissues in-vitro is regulated by the major source of calories in the preceding diet. Feeding of high fat-high protein diets alone or with thyroid reduce the normal growth of rats and cause hyperglycemia, fatty livers, hypertrophy of adrenals and reduction in adipose tissue weights to varying degrees. These diets induce increased acetoacetate production by liver slices without any parallel rise in its extrahepatic utilization. Influence of hormones on the relationship between ketogenesis and lipid metabolism is discussed in the light of the results presented.

304. Studies on the effect of vitamin B$_{12}$, unsaturated fat and glucose cycloacetoacetate on serum lipoproteins in experimental hyperlipemia.

D. M. BRAHMANKAR, K. S. MOREY, and M. C. NATH, Nagpur.

Effect of saturated fat, mixed fat and saturated fat along with Glucose Cycloacetoacetate (GCA) hydrolysed and vitamin B$_{12}$ was studied on the serum lipoprotein fractions of the rats. Serum beta-lipoprotein fraction and beta/alpha ratio, was higher in the animals given saturated fat than those receiving same level of mixed (saturated and unsaturated) fat and the animals fed saturated fat and treated with GCA (hydrolysed) and vitamin B$_{12}$. It was suggested that vitamin B$_{12}$, GCA (hydrolysed) and unsaturated fat (present in mixed fat diet) lowered higher beta-lipoprotein level and beta/alpha ratio through hypocholesterolemic effect in experimental hyperlipemia.

305. Effect of carbohydrates on the intestinal synthesis of thiamine in rats.

M. C. NATH and S. K. MEGHAL, Nagpur.

The ingestion of as little as 10% of glucose or sucrose by rats given a thiamine-free basal diet resulted in decreases in the daily urinary and faecal excretion of thiamine and these rats ultimately died of thiamine-deficiency during the 5th week of the experiment. Hydrolysed glucose cycloacetoacetate which has already been shown to enhance the biosynthesis of thiamine, could prevent the thiamine deficiency in rats fed on glucose or sucrose; the daily urinary and faecal excretion of thiamine then increased and the tissue content of thiamine was higher. Pectin was also found to enhance the biosynthesis of thiamine as it favoured the growth of coliform organisms in the intestine. Coprophagy was not prevented during the experiment. Cellulose and honey did not show any significant effect on the biosynthesis of thiamine.

306. Electrophoretic study of serum lipoprotein pattern in health and metabolic disorders.

M. C. NATH and INDU VAISHWANAR, Nagpur.

The lipo-protein pattern of 69 male healthy subjects and 88 patients of different metabolic disorders have been presented by using the method of paper electrophoresis.

It is suggested from the result that in normals with age, there is an increase in serum beta-lipoprotein fraction without appreciable alteration of lipids in the alpha fraction. The rise of cholesterol in the beta-lipoprotein was accompanied with moderate increase of phospholipids in this fraction leading to slight increase of Beta-cholesterol/phospholipid ratio.

An attempt for the comparison of the normal lipoprotein pattern with patients has been made in the present study and it has been noted that the beta-lipoprotein rise was much more conspicuous with considerable decrease in the alpha lipoprotein in the patients leading to a higher beta/alpha ratio over the normals.

Cholesterol rise was much more in the beta-lipoprotein fraction than the beta-phospholipid leading to much higher ratio of C/P in this fraction above the normals of all age groups. Hence the comparison of this ratio with the normals may be taken as a better index than beta-cholesterol level alone.

307. Studies on Vitamin A: Complexes of Vitamin A with salts of fatty acids.

SUKHAMOY BHATTACHARYA, Calcutta.

An attempt has been made to prepare complexes of Vitamin A with aluminium salts of fatty acids and to study the stability of the vitamin A in the resulting products under a variety of storage conditions e.g. at an elevated temperature (50°C), at room temperature (25°-35°C) and in the cold (below 5°C).

Preliminary observations tend to show that some of the fatty acid salts, when complexed with vitamin A have got considerable stabilizing effect on the vitamin. The level of vitamin A activity in these complexes has some bearing on the stability of the vitamin.

308. On the Problem of Controlled Hydrolysis of Nucleic Acid.

S. PAL and S. K. DUTTA, Calcutta.

Controlled non-enzymatic hydrolysis of nucleic acid as a method of cleaving long polyribonucleotide chains into discrete units of a size amenable to sequence and end-group determination is still a problem. Complete breakdown of nucleic acid (RNA) into its purines, pyrimidines, sugar and phosphate has been achieved by many workers (Levene, J. Biol. Chem (1922), *53*, 441, Chargaff *et al*, J. Biol. Chem. (1948) *176*, 715; Hotchkiss, J. Biol. Chem. (1948), *175*, 315, Marshak *et al*, J. Biol. Chem. (1951) *189*, 597). All these methods have some limitations when quantitative microestimation of the free bases have to be carried out. Attempt has been made to use trifluoro-acetic acid for controlled hydrolysis of nucleic acid, the observations of which were recorded. Studies on the nucleotides as well as on the free nitrogenous bases with anhydrous as well as hydrated trifluoroacetic acid under different conditions have also been made. Simultaneous liberation of free purines and pyrimidines from RNA with this acid was found complex. The problem has been discussed.

309. Purification and properties of Glucose-6-phosphate Dehydrogenase from rice seedling.

R. K. MANDAL and ASOKE G. DATTA, Calcuta.

Glucose-6-phosphate dehydrogenase (Zwischen ferment) has been purified twentyfive folds from extracts of 48 hours old rice seedling coleoptiles by ammonium sulphate fractionation and adsorption on calcium phosphate gel. The enzyme is active only with TPN and not with DPN. It contains some 6-phosphogluconate dehydrogenase activity. The enzyme shows no requirement for added Mg^{++}. Its optimum pH is 7·6. The Michaelis constant is $2{\cdot}8\times10^{-4}$ M for glucose-6-phosphate.

310. Isolation of a Low Molecular Weight Ribonucleic acid from Brain Nuclei.

SUBIR K. CHANDA and J. J. GHOSH, Calcutta.

A low molecular weight ribonucleic acid (RNA) fraction has been isolated from goat brain nuclei, by making use of the solubility in 2M NaCl. RNA, thus isolated was hydrolyzed in 0·3M KOH for 20 hours at 37°C to the individual mononucleotides, which were further analyzed by paper chromatography. Both guanylic and cytidylic acid content were found to be significantly higher than adenylic acid and uridylic acid content. In this respect, this RNA preparation from goat brain nuclei has some similarity to the low-molecular weight RNA preparations from *B. coli*, yeast and other sources. The ultra violet absorption properties of the RNA preparation has also been studied.

311. Effect of Vitamin B_{12} deficiency on the ammonia metabolism in rat brain.

(MISS) DIPALI BHATTACHARYA and J. J. GHOSH, Calcutta.

Vitamin B_{12}, like all other members of the B-complex group, plays an important part in the normal functioning of brain tissues. Very little is known on the role of vitamin B_{12} in protein and amino acid metabolism in brain. Comparative studies were made using whole brain homogenates as well as cortex slices from normal and vitamin B_{12} deficient rats regarding ammonia formation. It has been found that zero hour ammonia level is not much affected in vitamin B_{12}—deficient rat brain in comparison to that of normal. The ammonia suppressing effect of glucose, which is very prominent in normal brain tissues, is completely absent in brain tissues of vitamin B_{12} deficient rats.

312. Some properties of 18,20-dioxygenated steroids.

P. K. BHATTACHARYYA, B. D. KULKARNI, D. D. GODSE and MANSA RAM,
Poona.

The proximity of the angular methyl carbon 18 and the side chain carbon 20 in steroids causes some interesting steric interactions. These are particularly manifested in some 18,20-dioxygenated steroids obtained by partial synthesis from the "kurchi" alkaloids.

3β, 18, 20α-Trihydroxy-5-pregnene obtained in three stages from holarrhimine involving nitrous acid reaction, boron-trifluoride-acetic anhydride cleavage of the resulting 18-20β oxido products and hydrolytic deacetylation gave back a 18-20 β oxido compound on sublimation.

18-Hydroxyprogesterone, 11α, 18-dihydroxyprogesterone and 18-hydroxy-3 β-acetamido-20-oxo-5-pregnene (I) obtained from holarrhimine were found to exist almost exclusively in the 18-20 hemiketal form. Compound I on lithium aluminium hydride reduction gave the 18, 20α-ether instead of the expected diol.

Progesterone-18-carboxylic acid and its 11α-tosyloxy derivative were insoluble in bicarbonate and existed in stable 18-20 lactol forms. In contrast 3 β, 20 α diacetamido-5-pregnene-18 carboxylic acid behaved like a true carboxylic acid.

18-Hydroxy-3 β-N dimethyl-20-oxo-5-pregnene was prepared in two forms from conessimine, one (IIa), melting at 74° and the other (IIb) at 89°. Most of the physico-chemical properties including optical rotation and IR spectra of both these forms were identical. On reduction with lithium aluminium hydride IIa and IIb yielded two diols, (IIIa and IIIb), having melting points 165° and 146° respectively. These two diols were indistinguishable in their optical rotation and their solid-state IR spectra which indicated strong intramolecular hydrogen-bonding. On pyrolysis, however, they yielded two distinctly different carbonyl compounds by an unusual intramolecular hydride transfer reaction.

313. Adsorption of dyes by bacteria.

S. V. SOMAN, Nagpur.

The adsorption of dyes like crystal violet, saffranin, eosine, rhadamin B, and substances like sulphanilamide and iodine by organisms like *B. subtilis* and *E. coli* was investigated.

The washed experimental organisms were suspended in water to yield a resting cell suspension of desired bacterial count. The amount of the dye adsorbed by suspensions containing the resting cells, the heat killed cells and the acetone washed cells was investigated. Following conclusions were drawn from the above set of experiments.

(1) When the dye is adsorbed by intact bacterial cells the adsorption isotherm has a sigmoid shape.

(2) At higher concentrations the adsorbate appeared to form a multimolecular layer on the bacterial surface, suggesting a co-operative adsorption.

(3) When the permeability barrier of bacteria was destroyed killed the cells at 70°C or washing them with acetone the shape of the adsorption isotherm was found to be of the Langmuir type.

(4) From many other instances found in literature it was inferred that the Langmuir type of adsorption isotherm results when the adsorbate and the entire bacterial protoplasmic mass interact and are in true equilibrium, whereas a sigmoid isotherm results when the interaction takes place between the adsorbate and only the bacterial surface.

314. Microbiological transformations of terpenes. III—Transformations of some mono- and sesquiterpene hydrocarbons by *aspergillus niger*.

P. K. BHATTACHARYYA, B. R. PREMA, R. S. DHAVALIKAR and
B. V. RAMACHANDRAN, Poona.

The microbiological transformation of α-pinene to verbenol, verbenone and trans sobrerol by *Aspergillus niger* has been established. In continuation of these studies α-santalene, camphene, longifolene, β-santalene, carane, △³-carene and humulene were subjected to microbiological oxidation with *A. niger*.

α-santalene yielded tere-santalic acid, $C_{10}H_{14}O_2$ (m. 152-54°; n. equiv.=164; $[\alpha]_D$ (−)72° (benzene) in about 25 per cent yield along with small amounts of the corresponding alcohol *tere*-santalol, $C_{10}H_{16}O$ (m. 112-114 C) by fermentation with *A. niger*.

Under the same conditions, camphene, longifolene and β-santalene yielded the identical dicarboxylic acid which could be isolated only as the liquid anhydride, $C_{11}H_{16}O_3$, in maximum yields amounting to 30%, 40% and 35% respectively. The anhydride was characterized as hexylidine methyl succinic anhydride through its physico-chemical properties, degradation, and eventual synthesis by two independent routes.

Carane, Δ³-carene and humulene proved to be rather resistant to transformation by the experimental strain of *A. niger*.

315. Investigation of the oil from the seeds of Garcinia Xanthochymus.

B. K. SABATA and M. K. ROUT, Cuttack.

In the present investigation, the percentage composition of the mixed fatty acids of Garcinia Xanthochymus seed oil has been determined by two methods, (1) methyl ester fractionation, (2) stepwise addition of urea.

The results with regard to composition obtained from both the methods are indicated below :—

	Methyl ester fractionation method	Urea adduct method
Palmitic acid	40·3%	41·0%
Oleic acid	55·9%	55·5%
Linoleic acid	3·8%	3·5%

316. Factors influencing the Distribution of Zinc—65 in albino rats.

S. BRAMANANDAM, B. NAGARAJAN and V. M. SIVARAMAKRISHNAN,
Madras.

In continuation of our investigations on Cobalt-60 (vide Proc. Ind. Sci. Congr., 1960 & 1961), we have studied the effects of time, of increasing concentrations of various chelating agents, and of inert zinc-carrier on the distribution of Zinc-65 in albino rats. The tracer, injected alone, is deposited mainly in the liver, the bones, the skin and the muscles like Cobalt-60, but the excretion is comparatively slow and mainly faecal unlike cobalt-60 which is rapidly excreted through urine. The distribution is progressively altered by increasing concentrations of the chelating agent used; and with enough chelating agent, it is possible to produce a high localization of zinc-65 in the lungs by oxine and 2-methyloxine (about 60%) and in the liver by sodium diethyldithiocarbamate and rubeanic acid. Ethylenediaminetetraacetic acid considerably enhances the excretion, the chelate exhibiting a marked apathy for the liver, being preferentially deposited in the skin and the bones. All these changes are quite similar to those on cobalt-60. This suggests that provided a firm chelate is formed and the metal is at the tracer level, it may be the chelating agent rather than the metal that decides the specific tissue of preferential localization. Simultaneous administration of carrier-zinc, with the tracer or with the tracer plus the chelating agent, delays the tissue-deposition of radio-activity from the vascular compartment.

317. Search for potential filaricides.

A. B. SEN and K. SHANKER, Lucknow.

Fourteen carboalkoxybenzenearsonic acids and carboalkoxystibinic acids have been prepared. The required esters were obtained from p-aminobenzoic acid and p-aminosalicylic acid by esterification with n-propyl-, n-butyl-, isobutyl-, and n-hexyl alcohol. These esters were then converted into the arsonic acids by the Scheller-Bart reaction (C.A., *34,* 1632) and into stibinic acids by Bart-Schmidt reaction (J. Chem. Soc., 1930, 1937).

318. Influence of different acids on the lost activity of Yeast Invertase due to Ag+-ions.

M. M. BISWAS, Calcutta.

Activity of 50 c.c. of a 2% solution of vacuum dried yeast invertase was at first inhibited by 5 c.c. $\frac{N}{10}$ $AgNO_3$ solution. Invertase activity was measured by the concentration of reducing sugar formed by hydrolysis of 80 gm. sucrose by 50 c.c. 2% invertase solution in presence of 25 c.c. 10% Na_2HPO_4 solution in an incubator. 2·5 c.c., 5 c.c., 7·5 c.c., 10 c.c. and 15 c.c. volumes of $\frac{N}{1}$ HCl, $\frac{M}{1}$ phosphoric acid and 10% nucleic acid suspension in water were used in the activation experiments. Corresponding values of activity were 2·77 gm., 7·81 gm., 12·50 gm., 20·83 gm. and 41·66 gm with $\frac{N}{1}$ HCl., 2·31 gm., 5·68 gm., 15·62 gm., 17·85 gm. and 31·25 gm. with $\frac{M}{1}$ phosphoric acid and 0·80 gm., 1·04 gm., 1·66 gm., 1·92 gm. and 2·08 gm. with 10% nucleic acid. Activity figures for the three acids viz. $\frac{N}{1}$ HCl, $\frac{M}{1}$ phosphoric acid and 10% nucleic acid suggest that revival is highest with $\frac{N}{1}$ HCl., less with $\frac{M}{1}$ phosphoric acid and least with 10% nucleic acid. Increase of activity due to acids also corroborates the theory of displacement of $Ag+$ ions in the reactivation process.

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319. Electrolytic preparation of Uramil and diphenyl acetic acid.

H. P. AGARWAL and (MISS) S. L. KAPOOR, Bhopal.

The 5-nitro-barbutaric acid on electrolytic reduction at 60°C in 30% sulphuric acid, gave uramil using a current density of 3 milli amp./sq. cm. Similarly at room temperature benzillic acid in 10% solution of sulphuric acid is reduced to diphenyl acetic at a current density of 15 milli amp/sq. cm. The percentage yield in the former case is 50% and in the latter 53%. For greater yield the electrolysis will have to be prolonged for a longer duration than the theoretically calculated time.

In both the cases, the reduction was brought about in a cell in which catholyte was separated from anolyte by means of a fritted glass diaphragm. A copper foil served as cathode and a platinum foil as anode. The method can be extended for preparation of similar other compounds.

320. Miscella refining of castor oil.

R. R. GUPTA, K. N. AGRAWAL and A. C. GUPTA, Kanpur.

The refining of Castor oil in the miscella stage has been studied in the Laboratory. It was observed that about 50% miscella concentration and 3 to 9% alkali solution gave optimum results in respect of final F.F.A., colour and recovery of the oil. 2% excess alkali was found to be sufficient for neutralization to produce oil of 0·1 F.F.A. 0·3% aqueous solution of citric acid was used for final washing. The separation of soap in the miscella was quick and clear and it was found possible to separate it without using a third solvent. Centrifuging could also be used with advantage for separation of soap and miscella.

321. Kasipatnam Vermiculite.

ABDE ALI and T. R. BETARAYA, Hyderabad.

The vermiculite of Kasipatnam occurs along the margins of the apatite rich pegmatite and magnetite, in a valley about 5 miles from Kasipatnam, Vizianagaram Taluq, Visakhapatnam district, Andhra Pradesh. The properties studied and the tests made on the mineral were chemical and mineral analysis by X-rays, petrographic examination and differential thermal analysis; behaviour under Heating Microscope; specific gravity; hardness; treatment with some chemical agents and exfoliation. The results indicated that the material was an intermediate product resulting from the hydrothermal alteration of biotite and consists of unchanged biotite, hydrous mica and vermiculite. The suitability of this material for thermal insulation was ascertained by compounding the processed vermiculite in two sizes with varying amounts of Srirangapur clay and subjecting the previously fired test specimens to the following tests : drying, firing, and reheat shrinkages, apparent porosity, specific gravity, bulk density, water absorption, crushing and tensile strength and thermal conductivity. The data obtained showed that by the use of improved method of forming and subsequent heat treatment the vermiculite bodies can be fabricated suitable for thermal insulation up to 2000°F, product confirming to A.S.T.M. reheat tests.

322. Catalytic synthesis of iso-butyric acid from isopropanol and carbon monoxide at high pressure.

E. L. BAPTIST, S. N. NAG and S. K. BHATTACHARYYA, Kharagpur.

The synthesis of isobutyric acid from isopropanol and carbon monoxide has been studied in presence of nickel iodide silica gel catalyst, at a temperature, 180-300°C, and a pressure, 2000-6000 p.s.i.

A maximum process yield of 20·8% isobutyric acid based on isopropanol was obtained under the most favourable conditions (temperature = 245°C, pressure = 4400 p.s.i., residence period = 2 hours and mole ratio of propanol and carbon monoxide = 1 : 2·47) using a silica gel supported nickel iodide catalyst containing 84·1% NiI_2. The yield of isopropyl isobutyrate under those conditions was 12·7% based on isopropanol.

Addition of water to isopropanol enhanced the yield of acid at the cost of ester. Under the above mentioned conditions the maximum yield of isobutyric acid and isopropyl isobutyrate were 24·12% and 9·83% respectively when a solution of isopropanol in water containing 27·3 mole per cent isopropanol was used.

323. Catalytic synthesis of pivalic acid from tertiary butylchloride, water and carbon monoxide under high pressure.

G. B. PUROHIT, S. K. PALIT and S. K. BHATTACHARYA, Kharagpur.

A systematic study on the synthesis of pivalic acid from tertiary butylchloride, carbon monoxide and water was carried out in the presence of nickel iodide silica gel (Ni : Si = 50 : 50) catalyst under ranges of, pressure, 4200—5200 p.s.i., temperature 208°—290°C and residence period 2-4 hours. The main liquid products of the reaction were found to be pivalic acid and tertiary butyl ester of pivalic acid. Tertiary butyl alcohol was also found to be present in small quantities. An experiment without adding water as a reactant was carried out and very little ester was found to be produced.

Under the optimum conditions of pressure 4800 p.s.i., temperature 262°C, residence period 3 hours and catalyst volume 5 c.c. the maximum process yields of acid and ester on the basis of input tertiary butyl chloride are 16·55% and 13·75% respectively in the presence of nickel iodide silica gel (Ni : SiO_2 = 50 : 50) catalyst when the mole ratios of the chloride, water and carbon monoxide are 1 :6 :9·4.

324. Synthesis of methyl acrylate from acetylene, carbon monoxide and methanol under pressure.

A. K. SEN and S. K. BHATTACHARYYA, Kharagpur.

The present paper deals with the systematic studies on the synthesis of methyl acrylate using acetylene, carbon monoxide and methanol. Various catalysts have been tried but nickel iodide-silicagel (Ni :SiO_2 : :50 :50) was found to be the most active.

A maximum process yield of 46·82% based on acetylene was obtained using 5 c.c. of nickel iodide-silicagel catalyst (Ni :SiO_2 : :50 :50) at a reaction pressure of 35 atm., temp. of 190°C, residence period of 4 hours, and with a mole ratio of acetylene : carbon monoxide : methanol as 1 :1 :4·7.

The maximum yields of methyl acrylate with cobalt and iron iodide on silicagel catalysts were much less than that obtained with nickel iodide on silicagel catalyst.

325. Catalytic production of butadiene from ethyl alcohol by single stage.

B. N. AVASTHI, N. D. GANGULY and S. K. BHATTACHARYYA, Kharagpur.

One-step catalytic conversion of ethyl alcohol to butadiene has been exhaustively studied. The present paper embodies the results of investigations under the following heads :

I. Synthesis of butadiene in the fixed bed flow reactor in presence of a large number of single, binary and ternary oxide catalysts systems, totalling to 156 in number.

II. Synthesis of butadiene in a fluidised reactor in presence of catalyst systems, found to be active in the fixed bed operation.

III. Studies on the physico-chemical properties of the promising catalysts by the applications of Differential Thermal Analysis Technique (D.T.A.) and surface-area measurements and hence the correlations of the structural characteristics of the catalysts with their activity.

The influence of operating variables like temperature, feed rate, catalyst weight, method of catalyst preparation, water content of the ethanol feed, deactivation and reactivation of the catalysts, etc., was thoroughly and systematically studied both in the fixed as well as in the fluidised beds.

I. Of the fifty one single oxide catalysts, MgO, ThO_2 and ZrO_2 were found to be the most active. Using these catalysts, the maximum process conversions of alcohol to butadiene were 27·43, 36·02 and 35·49 per cent respectively under optimum conditions.

Sixty five binary oxide catalysts having different compositions were tested for their activity.

Al_2O_3-ZnO (60 :40) was found to be the best among all the catalysts tried. Using this catalyst, the maximum process conversion of ethanol to butadiene was 55·83 per cent at a temperature of 425°C and ethanol feed rate of 1·875 cc/hr/gm of catalyst.

Other promising binary catalysts were Al_2O_3—MgO (80 :20), $Al_2O_3-Fe_2O_3$ (60 :40), $Al_2O_3-Cr_2O_3$ (60 :40) and $ZrO_2-Fe_2O_3$ (40 :60). Using these catalysts, the maximum process conversions were 47·76, 37·70, 47·23 and 39·66 per cent respectively under optimum conditions.

The ternary catalysts (40 in number) in general showed poor catalytic activity.

II. Only those catalysts, which were found active in the fixed bed synthesis of butadiene, were tried in the fluidised condition.

The process conversions of ethanol to butadiene using the different catalysts under optimum condition in the fluidised bed reactor are given below and compared with those in the fixed bed.

Catalysts	Fluidised bed	Fixed bed
Al_2O_3	25·95%	23·98%
Fe_2O_3	25·66%	22·31%
ZrO_2	34·22%	35·49%
ThO_2	25·42%	36·02%
Al_2O_3-ZnO (60 :40)	72·89%	55·89%
Al_2O_3-CaO (60 :40)	28·83%	28·68%
Al_2O_3-MgO (80 :20)	35·26%	47·76%
Al_2O_3-Cr_2O_3 (60 :40)	34·74%	47·23%

III. Differential thermal analyses were done for the following systems :

(i) Single oxide catalyst system—MgO, SiO_2, Al_2O_3

(ii) Binary oxide catalyst system—Al_2O_3-MgO, Al_2O_3-ZnO Al_2O_3-Fe_2O_3

The thermal characteristics of the catalysts, as observed by D.T.A., were substantiated by surface area measurements by B.E.T. method.

Besides the above systems, the D.T.A. data for ThO_2, ZrO_2 Al_2O_3-Cr_2O_3 etc., reported earlier by Bhattacharyya and his school, were successfully correlated with their catalytic activity.

The salient features of the thermograms and their relations with the catalytic activity have been discussed in the paper.

326. Solvent Retentivity Experiments with Sugarcane Wax and Its Modified Derivatives.

S. BOSE and A. N. SHRIVASTAVA, Kanpur.

In order to make sugarcane wax suitable for use as hard wax in shoe polishes, it was de-ashed, defatted and bleached with chromic acid. The resulting refined wax was condensed separately with cellosolve, ethylene glycol, glycerol, mannitol, sorbitol, ethanolamine and ethylene diamine. Melting point, acid value and hardness of the modified derivatives were determined. Hardness was measured with Penetrometer. The m.p. and hardness value were found to be highest in the case of ethylene diamide wax; it was further indicated that hardness value of wax gradually increased after purification and modification.

Solvent retentivity of the different wax derivatives was determined by preparing their gels with turpentine oil (b.p. 160-170°). Modified waxes when used alone, possess a very poor solvent retentivity. When the wax and solvent ratio was 3 :7, cellosolve and glycerol ester showed highest solvent retentivity. When the ratio was 1 :4 all the gels were very soft and the gel containing crude cane wax did not set at all. Highest solvent retentivity under this condition was that of glycol ester wax. Using modified wax, paraffin wax (m.p. 58°) and solvent in the ratio of 1 :2 :7, the glycerol ester wax showed highest solvent retentivity and the surface, was quite smooth and shining. Gel, containing modified wax, paraffin wax and solvent in the ratio 2 :1 :7, showed good setting characteristic but in general solvent retentivity was rather poor. It is concluded that glycerol ester wax is the best available modified wax. Shoe polish samples prepared from it had better solvent retentivity than those prepared from other modified derivatives. Polish containing glycol ester wax also possesses same solvent retentivity but the surface is not so smooth and shining as that of blend containing glycerol ester wax. Polish cake containing glycerol ester wax sets well but its consistency is found to be rather soft. The firmness may be achieved by varying the proportion of hard wax and soft wax constituents in the blend or by addition of metallic soaps such as zinc and aluminium stearate.

327. Investigation of the composition of the fatty acids of the seed oil of *Butea frondosa* by urea-adduct method.

L. SARANGI, K. K. PATNAIK, M. K. ROUT, Cuttack 3

In the present work, attempts have been made to explore the suitability of urea-adduct methods for determination of the composition of the mixed fatty acids of the seed oil of *Butea frondosa.* The results of our investigations indicate that these methods can be effectively used for separation and identification of the different component fatty acids if the experimental conditions with regard to the amounts of urea, the solvent and that of the mixed fatty acids used are properly adjusted.

328. Activation of slag with lime or clinker.

S. K. CHOPRA and KISHAN LAL, Roorkee.

Activation of slag with small quantities of lime or Portland cement clinker has been studied. Early strengths of the wet mixes of ground slag (97·5 to 90 per cent) and lime or clinker (2·5 to 10·0 per cent) were taken as an index of activation (or hydraulicity). The hydrated mixes were examined for the identification of the cementitious phases.

The strength development is of the same order with either of the two activators. Poorly crystalline calcium silicate hydrate (I) tetra-calcium aluminate hydrate, and a hydrogranet are the main hydration products formed on the hydration of the either mix. Unreacted lime is present in mixes originally containing lime more than 5 per cent. On the other hand no lime is present in clinker slag mixes. Since the clinker contains only 42 per cent 3 CaO. SiO_2 and free lime for activation is released only through its hydration, it would appear that compared to lime-mixes the corresponding clinker-mixes contain a much lower quantity of lime available for activation. But the strengths being practically of the same magnitude, it may be inferred that the intrinsic strengths of the cementitious phases formed in the two series are probably different.

329. "Fatty acid esters of Sucrose from molasses as detergents."

M. V. KALE and K. K. DOLE, Poona 4.

Sucrose fatty acid esters have been synthesized by trans-esterification between sucrose and fatty acid esters of volatile alcohols. The sucrose monoesters are excellent non-ionic detergents and emulsifying agents. They are found to be non-toxic and non-irritant and are easily assimilated in the human system.

Molasses contain 35 to 40 per cent of unrecovered sucrose. Refined molasses is esterified by trans-esterification method to obtain sucrose mono—and di-esters using an alkaline catalyst. Sucrose mono—and di-stearates are preapred and identified. Work of preparing other fatty acid esters, improvement in the technique of the reaction and assessing the detergent and surfactant properties is being continued. Possibility of using dried molasses for esterification directly and better and cheaper methods of refining of molasses is also being investigated.

330. Studies in the Molecular Weight of Dehydrated Castor Oil.

S. G. GOGATE and K. K. DOLE Poona 4.

It has been observed in previous investigation that polymerization of DCO is influenced by the catalyst used in the dehydration process. Intermolecular and intramolecular reactions take place and consequently the type of polymerization varies. In intramolecular polymerization, decrease in iodine value takes place quite rapidly but molecular weights do not show proportional increase. In intermolecular polymerization, the drop in iodine value is proportional to the increase in molecular weight. This leads one to investigate the molecular weights of DCO samples Polymerized and unpolymerized quite thoroughly. Therefore, molecular weights of DCO samples have been studied in the present investigation by two different methods :—

(1) Cryoscopic Method;
(2) Viscosity Method.

Molecular weights determined by these two methods of the same sample of DCO show some variation. The molecular weight as determined by viscosity method shows large value than the one determined by cryoscopic method. More the polymerization of DCO sample, more is the difference in these values of molecular weights. The study of causes of this difference in molecular weights is in progress.

331. Polarity-finder for dry storage batteries.

U. H. NARAYANAN, Karaikudi.

An instrument for the detection of polarity of dry storage batteries has been designed and fabricated employing an electrometer circuit with a Philips 4067 tube. The output of the electrometer circuit is suitably amplified to drive a centre zero d.c. microammeter. The direction of deflection in the microammnter shows the correctness or otherwise of pole markings. Furthermore, any short-circuiting of the formed plates inside the battery can also be detected as it would cause a null deflection in the indicating meter.

332. Urea Fractionation of Linseed Oil Fatty Acids: A comparative study by cumulative and elution methods.

T. N. MEHTA and M. S. MURTHY, Nagpur.

The fatty acid composition of linseed oil was determined by two urea fractionation procedures. A simple cumulative urea fraction procedure was found to give results similar to those obtained by urea adduct elution method. Compositions calculated by these methods agree fairly well with the compositions given by other workers.

333. Industrial applications of clay mineralogy.

V. S. RAMCHANDRAN,Roorkee.

In the field of clay mineralogy attention has mainly been directed to the identification and estimation of clay mineral components of various clays by techniques like X-ray diffraction, electron microscopy, staining, differential thermal, thermogravimetric and infrared analyses. Only recently has the practical utility of basic research in clay mineralogy been realised.

Since the physical and chemical properties of clay materials are mainly dependent on the structure, composition and properties of clay minerals a knowledge of clay mineralogy is essential in industrial practice where clays are involved.

A few of the applications of clay mineralogy include ceramics, catalysis, constructional engineering, petroleum industry, foundry, paper manufacture, lubricant & plastic industry and agriculture.

Clay mineralogy may find application in unexpected fields. For example, the type and content of the clay mineral will indicate its usefulness for disposing off hot undesirable isotopes from nuclear reactors. The mineralogical composition of a clay would be an important factor for assessing its suitability for the manufacture of clay lightweight aggregates. A quantitative determination of the clay minerals in brick clays will provide an accurate estimation of the thermal efficiency of kilns.

334. Limiting Dephosphorisation of Iron-Phosphorus Alloys in Hydrogen at 1000°C.

B. CHATTERJEE, Howrah.

In continuation of our work on the limiting dephosphorisation of Alloys in Hydrogen, the removal or otherwise of phosphorus from an Iron-Phosphorus alloy (1·94% P) as also from the Iron-Phosphide separated from this alloy using electrolytic method (citrate cell) has been studied. The effect of particle-size of the alloy on the dephosphorisation reaction has also been investigated. No dephosphorisation could be observed on annealing this Iron-Phosphorus alloy in flowing hydrogen containing 1·2 per cent by volume of moisture for 10 hours at 1000°C. The phosphorus content of the alloy did not show any reduction on treatment with moist hydrogen at 1000°C even when the surface area of the powdered alloy was increased 5·72 times by decreasing the particle-size. This observation indicates that diffusion of hydrogen into and of phosphorus out of the alloy does not seem to play a very marked role on the dephosphorisation reaction under study. The phosphide (15·1%P) separated from this alloy, on the other hand, have been found to suffer considerable dephosphorisation on annealing in moist hydrogen at 1000°C. These results support our previous observation, viz., if the phosphorus content of the alloy is below 2%, dephosphorisation of the alloy by hydrogen at 1000C is rendered very difficult and that dephosphorisation takes place in the phosphide phase.

335. Comparative study of the catalytic esterification of saturated carboxylic acids with ethylene at high pressures.

C. R. LAHIRI and S. K. BHATTACHARYYA, Kharagpur.

The reactions involving the esterification of acetic, propionic and n-butyric acids with ethylene have been studied in a static reactor at a temperature, 150 to 215°C and a pressure, 50 – 300 atmospheres, using suphuric, hydrochloric, hydroiodic phosphoric acids, anhydrous zinc chloride and ion exchange resin as catalysts. Sulphuric acid has been found to be superior to other catalysts studied. The yields of ethyl esters of the above acids under optimum conditions using sulphuric acid as a catalyst are given as follows :

	Temp., °C	Maximum pressure, atm.	Residence period, hr.	Mole ratio of ethylene to organic acid	Yield % ester
Ethylacetate ...	170	85	3	3·09	38·12
Ethylpropionate ...	170	130	3	7·33	28·67
Ethylbutyrate ...	185	136	3	6·64	28·42

336. Acid activation of inert clays and conversion to insecticidal substances.

K. KRISHNAMURTHY, S. GODAVARIBAI and S. K. MAJUMDER, Mysore.

ACID activation of kaolinic, montmorillonitic and Illitic clay samples resulted in insecticidal substances. Kaolinic clays were more insecticidal than the other clays. Comparatively, H_2SO_4 activation resulted in better insecticidal property than HCl activation. Post-activation heat treatment of the samples at 110 and 400°C showed that the insecticidal activity of the materials was considerably enhanced with the latter. Heat treatment alone did not induce permanent insecticidal activity of the clays. Acid activation was found to be essential for inducing permanent activity. Methylene blue absorption decreased and oil-bleaching properties increased of the clay progressively with the activation treatment with higher levels of acid, longer time and increased pressure, during activation and drying at 110°C.

337. On the study of indirect application of radioactive nuclei in analytical chemistry. Part IV.

B. C. PURKAYASTHA and A. K. DAS, Calcutta-9.

In a previous communication it has been shown that through indirect method of analysis by radioactive nuclei, elements of γ order of magnitude can be estimated with a fair degree of accuracy. In the present investigation estimation of palladium as PdI_2 has been undertaken using I^{131} as a measuring indicator. The principle empoyed in such estimation is as follows :—Excess of Iodine (double or three times the theoretical amount as required by the equation $Pd^{++} + 2 I \longrightarrow Pd I_2$) as KI containing I^{131} is added to unknown palladium in slightly acid solution. The trace of PdI_2 is co-precipitated along with zirconium phosphate. From the loss in activity of I^{131} in the filtrate the amount of palladium present can be computed. Palladium ranging from 1×10^{-3} gms to 1×10^{-6} gms has thus far been estimated within a fair degree of accuracy. The method can be claimed to be very rapid and dependable. Mechanism of uptake of PdI_2 by zirconium phosphate is under investigation. This study gives further supports to our previous finding published elsewhere that choice of a selective co-precipitating agent may also enable us to estimate any element present in such a trace amount (10^{-6} gms) by radiometric procedure.

NUCLEAR CHEMISTRY

338. Deposition of radioactive tracers on preformed ionic precipitates : Part V—Adsorption of Orthophosphate ions on ignited strontium sulphate.

K. R. KAR and M. M. BHUTANI, Delhi.

In continuation of an investigation, undertaken in this laboratory, on the deposition of radioactive tracers on preformed micro crystalline solids, the carrying of carrierfree orthophosphate ions ($P^{32}O_4'''$) by ignited strontium sulphate has been studied. The deposition of the radionuclide has been examined under three aspects, viz., (i) instantaneous deposition, in the absence as well as presence of the added lattice and certain nonlattice ions, as a function of pH values of the aqueous suspension medium; (ii) instantaneous adsorption as a function of the concentration of the lattice and certain nonlattice ions, the pH of the suspension medium remaining constant; (iii) carrying as a function of the time of contact of the radionuclide with the carrier surface, under various experimental conditions.

The dominant roles of pH, lattice and various nonlattice ions and also the influence of time of contact of the tracer in influencing the deposition process, have been borne out by the experimental results. On the basis of the observed facts, the carrying process has been postulated to be due to surface adsorption, in all probability, by the counter ion exchange mechanism.

339. On the study of indirect application of radioactive nuclei in analytical chemistry. Part III.

B. C. PURKAYASTHA and A. K. DAS, Calcutta.

In a previous communication application of co-ordination compounds to extend the use of I^{131} an easily available isotope of convenient half life, in the determination of mercury and cadmium was reported. Present study deals with further extension of the work to the determination of bismuth. The principle employed is to add excess of oxine and iodide mixture labelled with I^{131} to a slightly acidic solution containing bismuth and to measure the activity of a portion of the solution with a liquid counter. The loss in activity is a measure of the amount of bismuth present on the assumption that bismuth is precipitated as $(C_9H_7ON)H(BiI_4)$ under experimental conditions.

Bismuth from 10 mg. to 0·05 mg. has thus far been estimated. The data lies always within statistical fluctuations. It can be claimed to be a very quick and reliable method even in very small concentration as mentioned above.

340. Studies on RNA synthesis in *Azotobacter vinelandii* I. Distribution of P^{32} in the Ribonucleic acids of *Azotobactor vinelandii* labelled in vivo.

R. K. MANDAL and D. P. BURMA, Calcutta.

Intact cells of *Azotobacter vinelandii* readily incorporates P^{32} as inorganic phosphate into RNA when incubated in presence of an energy source like sucrose. When the cells labelled *in vivo* are disintegrated and subcellular fractions are separated by differential centrifugation, the particulate fractions are found to be labelled many times more than the soluble supernatant. Isolation of the P^{32}-labelled RNA by phenol followed by its gradient elution chromatography on DEAE-cellulose anion exchanger also confirms the idea that in intact cells, particulate RNA is synthesised first which may subsequently find its passage into the soluble fraction.

341. Mass-spectral analysis of Tetramethyl lead.

J. SHANKAR, M. R. GHATE and K. N. BHIDE, Bombay.

The cracking patterns of tetramethyl and tetraethyl lead have been studied at various ionizing voltages with the type 21-103C CEC mass-spectrometer. Suitable conditions for the isotopic analysis of lead have been discussed.

342. Isotopic exchange in the cobaltous-cobaltic system: (II) Heats and entropies of exchange.

J. SHANKAR and B. C. deSOUZA, Bombay.

The thermodynamic quantities for two paths present in this system as shown previously by the authors, have been evaluated. For the acid independent path, the ΔH and ΔS values have been found to be $12{\cdot}6 \pm 0{\cdot}5$ Kcals and -14 ± 2 eu. respectively, while those for the acid dependent path were $11{\cdot}6 \pm 2{\cdot}5$ Kcals and -11 ± 7 eu. The first hydrolysis constant of the cobaltic ion has been found to be $11{\cdot}7 \times 10^{-3}f$ at 0°C. The value of Δ H and Δ S were found to be 11 ± 3 Kcals and 29 ± 11 eu. The ionic strength was maintained at 1·0 throughout.

343. Recoil effects of cobalt-60 in (n, γ) reactions in tris acetylacetone Co (III) diluted with tris acetylacetonerhodium (III).

J. SHANKAR and MANOHARLAL, Bombay.

Studies on the (n, γ) reaction in tris acetylacetone cobalt (III) diluted with isomorphous rhodium complex are described in this paper. Compared to the undiluted cobalt complex, these studies reveal a lowering of initial retention on dilution. Similarly in thermal annealing studies, the diluted samples show lower saturation values ($R\propto$), even though the annealing rates are faster. In all these experiments, dilution with the rhodium complex has a less pronounced effect than with the aluminium complex.

344. Uranium-232 build-up in converter reactors (Part I—Thermal neutron irradiation).

HARI SINGH, V. K. SUNDARAM and D. V. GOPINATH, Trombay.

When thorium is irradiated with neutrons in converter reactors, certain amount of uranium-232 is also formed along with the fissile material uranium-233. Uranium-232, having 74 years half-life and a long chain of short-lived alpha-emitting daughters, increases the alpha activity and poses handling hazards of the irradiated material. Further, in cyclic irradiation of thorium (i.e. irradiation-cooling-processing for U-233 removal-irradiation) build-up of thorium-228 in the thorium mass increases with the number of cycles. In the present paper is evaluated the build-up of the above in converter reactors using Indian thorium. Due to the presence of uranium in the Indian monazite ore, the composition of Indian thorium is different from that of natural thorium. The various modes of production of uranium-232 from Indian thorium are described and the activity build-up from these different modes under the neutron flux conditions obtained at the blanket position of CIR is calculated. Build-up of thorium-228 in the irradiated mass in cyclic irradiation is calculated for varying cycle parameters.

345. Mineral Content of Fresh Waters and Fresh Water Organisms.

R. VISWANATHAN, Y. M. BHATT, J. R. NAIDU, G. R. DOSHI and C. KANNAN UNNI, Trombay.

The dry ash from species of fresh water fish and prawns in Maharashtra and Gujarat States has been chemically analysed for content of copper, iron, calcium and potassium. Calculations of ratios of mineral contents of the biomaterial to the corresponding concentrations in the respective fresh waters indicate that among other things differences exist between fishes and prawns in regard to concentration factors for copper and calcium.

The significance of the study of concentration factors is stressed in the context of determination of maximum permissible concentrations of radioactive isotopes in the aquatic environment.

346. Estimation of radionuclides in trace amounts in water.

M. C. MEHTA, Trombay.

Certain synthetic inorganic compounds act like organic resins as cation exchangers. In this paper, cation exchange properties of ammonium-12 molybdo arsenate are described and its possible use is suggested in the estimation of certain elements present in trace amounts in water.

Efficiency of this compound has been tested by employing the radioactive tracers of cesium, strontium, cobalt, scandium and cerium; conditions are described for the maximum absorption and quick elution of cations from a column of the heteropoly compound.

Quantitative recoveries have been observed in case of cesium, strontium and cobalt. Exceptional behaviour in case of cesium is encountered; radio cesium exchanges permanently with this compound. It has been observed that trace amounts of cesium-137 can be beta counted with the compound without employing self absorption corrections. The method offers a quick separation of radio cesium from a mixture of radionuclides.

347. Partition Function Ratios and Equilibrium Constants for Oxygen-18 Exchange Reactions.

S. C. SAXENA, D. N. BHATNAGAR and S. RAMASWAMY, Bombay.

Partition function ratios and the equilibrium constants have been calculated for oxygen exchange between several molecules and ions. The latest available frequency assignment data are used, and the various possible exchange reactions for the production of Oxygen-18 are critically examined.

348. Production of enriched N-15.

D. GUPTA, M. GANESAN, M. N. NAYAK, S. D. PAUL, Bombay.

N-15 has been produced in concentrations of 90% and above using the chemical exchange process between Nitric Oxide and 8N Nitric Acid with a simplified column assembly and with minimum amount of moving parts and instrumentation. The process flow sheet, instrumentation and some of the major problems encountered in obtaining the required enrichment has been discussed.

349. Study of radioactive disequilibrium of uranium in ores and minerals : Preliminary studies on the quantitative ion-exchange separation of the various daughter products of uranium.

P. P. PAREKH, Bombay.

The study of the mode and the degree of radioactive disequilibrium in uranium bearing ores and minerals can provide important clues to the geochemical history of such deposits.

The above information can be obtained by isolating the key-isotopes viz., U-238, Th-230, Ra-226 and Pb-210 of the U-238 series in radiochemically pure forms, and comparing their abundances with the equilibrium abundances of the corresponding isotopes present in a uranium ore known to be in perfect radioactive equilibrium. In the present paper, a scheme of anion-exchange separation of the key-isotopes in Cl^- and NO^-_3 media at different acid concentrations has been presented. Quantitative retentions and recoveries of the key-isotopes in the two media at different acid concentrations have been evaluated, using suitable representative tracers of the key-isotopes.

350. Isotope Exchange Reaction Between Iodide and Iodate Ions.

H. J. ARNIKAR and R. TRIPATHI, Varanasi.

It is shown that paper chromatography can be employed conveniently for studying the high temperature isotope exchange reaction between iodide and iodate ions. Results are reported for the reaction velocity and period of half-exchange for the reaction at 240°C for three different equilibrium concentrations of the reactants, studied by this method. Data show the existence of an initial induction period which is, probably, associated with the formation of iodine and free acid in trace, the iodide-iodate isotope exchange being considered non-occurrent in a neutral medium of the pure reactants.

351. Study on the probable existence of Potassium indium alum with radioactive nuclei.

B. C. PURKAYASTHA and HIMADRI BIJOY DAS, Calcutta.

Distribution studies with In^{114} as guest and potassium ferric alum as host at 5°C show that homogeneous partition factor (D) comes out constant. Indium tracer is therefore taken up by the host lattice through mixed crystal formation. In consideration of the analogy of ferric iron to indium in such system conclusion can be derived that thus far unknown potassium indium alum does also exist. The value of the partition factor (0·4) indicates that the alum in question is much more soluble than potassium ferric alum. Study in known systems like Ga^{67} as guest and ammonium ferric and potassium chrome alums as hosts and In^{114} as tracer and ammonium ferric alum as carrier (where corresponding alums of the guest elements are known) gives further support to our finding that unknown potassium indium alum does exist.

352. On a search on the existence of scandium alum with Sc-46.

B. C. PURKAYASTHA and K. N. DUTTA, Calcutta

Distribution study with Sc^{46} as tracer and ammonium ferric alum $NH_2Fe(SO_4)_2, 12H_2O$ as a host lattice at 4°C shows that homogeneous distribution factor (D) comes out constant over a wide range of concentration of the tracer ion. Uptake of scandium by ferric alum therefore takes place through mixed crystal formation. In consideration of the analogy of scandium with iron it can be claimed that the uptake of scandium through mixed crystal formation is a positive evidence on the existence of thus far unknown scandium alum. Radioactive indicator thus finds an useful application to expand our knowledge even in search of such an interesting compound where classical methods of attempt are not feasible.

It is of interest to point out that Mendeleef predicted that scandium (ekaboron) will not form any alum. Evidence that we have gathered gives, however, a positive hope that scandium will also behave like other neighbouring tervalent elements which are wellknown to form alum and under favourable circumstances scandium alum may also be isolated. Details as regards our study on transition temperature and isolation of the alum in question are under progress.

353. On the indirect application of radioactive nuclei in analytical chemistry. Part V.

B. C. PURKAYASTHA and V. R. PAI VERNEKER, Calcutta-9.

Sc^{46} has been used to examine the validity of the methods for estimating scandium. It has been found that the method based on the precipitation of scandium as hydroxide and its subsequent ignition is a dependable one. It has also been observed that scandium even in sulphuric acid medium undergoes complete hydrolysis when boiled with iodate and iodide mixture. The iodine liberated in the process can be collected and estimated either by hypo titration or by radiometric method with I^{131}. In case of radiometric procedure scandium up to 0·09 mg can be estimated with fair degree of accuracy. Using labelled pyrophosphate ($Na_4P_2O_7$) scandium up to 0·9 mg. has been estimated by radiometric method within statistical fluctuation. Rare-earths do not interfere in the estimation of scandium as pyrophosphate.

SECTION OF GEOLOGY AND GEOGRAPHY

President : Dr. K. P. Rode, M.Sc., Ph.D. (Zurich), F.A.Sc., F.G.M.S.

Abstracts.

GEOLOGY

(i) Mineralogy

1. New occurrences of Beryl from Palamau district, Bihar.

G. K. MODAK, Calcutta.

Occurrences of Beryl have been recorded for the first time by the author from (1) Dhangaon and (2) East of Banai in the district of Palamau, Bihar.

At Dhangaon (24° 01′ : 84° 14′ 30″) pale greenish coloured beryl occurs scattered in a nearly vertical beryl bearing white quartzvein. The Beryl bearing white quartz vein trends N (65-70) East—South (65-70) west and occurs beneath the surface. The country rock is Archaean granite gneiss traversed by the beryl bearing quartz vein.

Another beryl bearing mica-pegmatite vein intrusive into the granite gneiss, has been located on the hill about one and a half miles East of Banai. The beryl bearing mica-pegmatite vein strikes N 75 E—S 75 W i.e. due E-W and is traceable for a distance of about 450 feet along the strike, and the width of the vein varies from 20 feet to 100 feet. Beryl occurs here interlocked in the quartz core of the zoned pegmatite intrusive into the Archaean granite gneiss.

The chemical analyses of the two samples from each of the locality show 12·52 and 11·18 per cent of BeO respectively.

In view of the high percentage of BeO detailed prospecting would be desirable.

2. Perthites in Nepheline Syenites of Koraput, Orissa.

MIHIR KUMAR BOSE, Calcutta.

Perthites in nepheline syenites of Koraput are composite types. The striking feature of the intergrowths is the regularity in orientation of the albite units. The different types have been studied in oriented thin sections. The albite strings and films are arranged on an ortho-hemidome and the coarser bands are developed close to (100) of the host. Braid perthites are composed of two sets of albite spindles oriented along the prism directions. Albite frequently forms patches near the margin of the perthite grains from its tendency to move out of the host. Nature of the grain contacts and textural features suggest the patch perthites to be genetically connected with discrete albite in the rocks. Grain contact counts reveal the development of albite rims to be overwhelmingly associated with nepheline-perthite contacts. Such rims in optical continuity with intergrown albite in the perthite are likely due to interchange of soda and potash of adjoining minerals. Guttate perthites are relatively rare. Antiperthites are developed due to extensive replacement along (100) and (001) of the host by albite.

Composition of perthite, determined by point counting, camera lucida drawings and chemical analysis, is found to range about $Or_{54}Ab_{46}$. Relative abundance of various types of perthites across the body has been studied. Intergrowths are primarily due to exsolution, supplemented by later corrosion and replacement. The perthites, their composition and evolution suggest a magmatic history of the rocks containing them.

3. Clay mineralogy of the Rajahmundry Sandstones and Chintalapudi Sandstones from Nuzvid area. Andhra Pradesh.

B. B. G. SARMA, Waltair.

Clay mineral extracts from shales and shaly sandstones of Chintalapudi stage and of Rajahmundry sandstone series from Nuzvid area (eastern half of G.T.S. Sheet No. 65 (D/13) were studied by X-ray methods. A CuKa target was used with a camera of radius 57·2 mm. The time of exposure was uniform in the case of all the samples. Samples of Chintalapudi stage gave characteristic lines only for kaolinite. Samples of Rajahmundry series gave lines for kaolinite, illite and chlorite with kaolinite making up the bulk.

Clay minerals have a very wide range in chemical composition and are consequently very sensitive to changes in physico-chemical conditions at the time of formation. Therefore, theoretically in a palaeoenvironmental study, clay minerals will be useful. There is no general agreement on the utility of clay minerals as indicators of absolute environments. But most of the workers feel that, when several environments are present, it is possible to assign them a sequential order ranging from more continental to more marine, on the basis of their clay mineralogy.

The Chintalapudi sandstones on the basis of the clay minerals seem to be purely continental; coupled with the other data available about these rocks, it is concluded that they are fresh-water lake deposits. On the other hand, the Rajahmundry sandstones show an admixture of clay minerals. Since it is dominated by kaolinite, the environment also may be dominantly continental, but the admixture of illite and chlorite would indicate marine influence. They may be estuarine deposits.

4. Mineralogical study of Raghavapuram Shales from Duddukur area, Andhra Pradesh.

B. B. G. SARMA and V. RAMESAM, Waltair.

Variegated shales belonging to the Raghavapuram stage of the Gondwana system of rocks outcrop in the Duddukur area near the villages of Yelachintalagudem (17° 6′; 81° 33′ 30″) and Peddapuram (17° 6′; 81° 34′ 15″) as a band roughly running E-W and dipping gently to S.E.

The heavy mineral assemblage from the shales is characterised by a predominance of tourmaline. The immediately older Gollapalli sandstones have a much lower content of tourmaline and good amounts of kyanite and sillimanite. An antipathic relationship seems to be indicated. It is suggested that the tourmaline present in the shales is authigenic in origin and has formed at the expense of kyanite and sillimanite, boron and silica having been derived from sea-water and alumina from kyanite and sillimanite. A similar explanation was offered earlier (Keith and Degens, 1959).

Thermal analysis and Dye techniques revealed the presence of illite and chlorite as the clay minerals present. Illite and chlorite indicate a marine environment (Weaver, 1960), considered in conjunction with typical marine fossils in Raghavapuram shales from elsewhere (Krishnan, 1960) the clay mineralogy can thus be used as a valuable criterion in determining the depositional environment.

5. Anti-symmetrical nature of fixations of components and significance in Geology.

AMITAVA DUTT, Giridih.

Let us consider a harmonic oscillation model of an isolated, normal liquid system having many components cooling from high temperature. Components having different mass, volume and energy are generally in different energy states and may broadly show different concentration zones. The components of neighbouring zones colliding with each other at high velocities react with suitable activation energy at favourable conditions. If only a particular group of components is considered, then with their cooling their absolute activity and entropy as a function of temperature, volume and composition will decrease and compotents will attend fixation at minimum potential conditions.

If the partition function is taken as -E(energy)/kT then the variation in absolute activities from initial to fixation states is 2 sinh (-E/kT) showing exponential graphs. Similarly if partition function is taken as (1-exponential of -hv(frequency)/kT), variations in the free energy of components from liquid at high temperature to crystalline state when plotted shows anti-symmetrical curve. On both cases fixation function is antisymmetrical and therefore unique. In other words, not more than one characteristic component may be fixed at a time and given condition, resulting in only unitary appearance of a characteristic mineral. Successive ensembles of minerals at equillibrium conditions show the difference of one only.

(ii) Petrology

6. On the Rhyolites of Pavagad Hill.

S. C. CHATTERJEE, Bhopal.

Rhyolites are found forming the topmost turret of the main Pavagad Hill and are also found on its eastern slope and ridge and again on the top of the isolated northern hill. It forms also an outlier to the south-east. It is believed by some that all the rhyolites in the different parts of the hill are derived from the topmost flows, while there is an alternate view that they are *in situ*. In this paper a detailed petrographic description of the rhyolites is given and it is shown that at the top there are tuff flows in addition to flows of viscous lava. A comparative study based on the mode of occurrence in the field, petrographic characters and chemical composition is presented in the paper and it is shown that while many of the boulders along the pilgrim route have rolled down from the top, the rhyolites on the eastern flank and on the northern ridge are *in situ*.

The source of the rhyolite magma is briefly discussed.

7. Some aspects of the Petrochemistry of the Deccan traps.

S. K. SAXENA, Bhopal.

A small progressive change is noted in the chemical composition of the Deccan Traps from the lower to the Upper traps when the oxide percentages are plotted against the differentiation index values. The differentiation index values as devised by Thornton and Tuttle when calculated for the normal basalts fall within the values of 25 and 45. The Lower Traps show values around 29 and the Upper Traps show values around 39. There is a regional distribution of these values and towards the west more and more differentiated (in a limited sense) flows occur.

Trend of differentiation as noted within the normal basalt is not towards the production of felsic rocks. There are no intermediate rocks between the felsites and the basalts, therefore the differentiation curves (differentiation-index plotted against oxide percentages) should not be prolonged to the felsic end as has been done by Sukheswala and Poldervaart.

Till more work is done to prove the relation of the normaltraps to the ultrabasic and acid rocks noted in western India, these should be treated as separate magma entities. The type of progressive change noted can be due to limited unmixing in a gravitative molecular differentiation.

It can be argued from the differentiation index values that the thick flows near Bombay may contain the whole sequence from the Lower to the Upper Traps and as such this area might have been the foci of fissure eruptions from where spread the lava flows.

The need of more planned geochemical work is felt and expounded.

8. Study of the selective alteration of the Ultrabasics of Bhimtangar (Sukinda) area, Cuttack district.

M. MOHANT, Cuttack.

The area studied for the ultrabasics and the chromite ores occupy about 30 sq. miles and is bounded by 21°·0′ n—21°·4′ N and 85°·45′ E—85°·52′ E. The altered and unaltered ultrabasic rocks are found in form of steeply inclined isolated lenses running parallel to each other in a NE-SW direction which happens to be the axis of the iso-clinal anticline fold of the quartzite into which they have intruded concordantly. The NE-SW trend conforms to the Eastern Ghats strike and these rocks are connected with the Eastern Ghat orogeny. This type of ultrabasic association is called the Alpine type by Benson. Two of the three varieties of primary ultrabasics have been recognised in the field on the basis of their selective alteration. Those two have been doubtfully taken by the author as Iron-rich dunite (?) which has been lateritised and silicified and the other as Magnesium-rich dunite (?) altered to talc-serpentine schist. The third variety is the unaltered enstatite peridotite rock which is very fresh. The study of the alteration of this suits of ultrabasics is very interesting. The chemical nature of the primary ultrabasics has governed the alteration. Both the Iron-rich and Magnesium-rich ultrabasics have undergone hydrothermal alteration and solution has been derived from the ultrabasic magma. In the former case Iron oxide (altered to limonite), secondary quartz and very little specks of antigorite have been formed. The rock has been lateritised under tropical conditions. In the latter case greater amount of antigorite and small amount of talc have been formed. Talc occurs at the expense of antigorite suggesting that serpentinisation was older than steatisation. A late-magmatic (residual-liquid injection type) of origin has been assigned to the chromite ores occurring in the shear zones of the talc-serpentine schist and lateritized-silicified rock.

9. Occurrence of calc-silicate Rocks around Dhanwar-Jamua area, Hazaribagh district, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

Calc-silicate rocks, recorded for the first time in the area lying between latitudes 24°12′—24°30′ and longitudes 85°45′—86°15′ in the district of Hazaribagh, Bihar, form concordant narrow elongated and discontinuous patches and small mounds and elongated ridges in granite gneisses and schists. They are mostly granulitic, in places gneissic schistose in structures.

The calc-silicate rocks include the following types :

(1) Calc-granulites represented by diopside-garnet-epidote allanite-, diopside-garnet-hornblende-allanite-epidote-, garnet-epidote-allanite-, enstatite-diopside-clinoestatite-garnet-, zoisite-allanite-hornblende-augite-, diopside-hornblende-actinolite-, hornblende-epidote-, hornblende-diopside-epidote-, zoisite-clinozoisite-spidote-allanite-, epidote-garnet-actinolite-, hornblende-epidote-allanite granulites.

(2) Calc-schists the varieties of which are hornblende-diopside- tremolite-actinolite schists.

Felspars (plagioclase mostly) are among the essential minerals. Sphene, magnetite, ilmenite altering to leucoxene and quartz are the common accessories. Under the microscope epidote is usually green with grains of allanite as occasional inclusions. These allanites often produce radial cracks in epidote perhaps due to radioactivity.

10. Superposed metamorphisms in south-east Chotanagpur and adjacent areas.

P. S. CHAKRAVARTY, Jadavpur.

Some evidences which indicate polymetamorphism was prevalent in different parts of South-east Chotanagpur and adjacent areas are recorded. Sources of the evidences are (1) Age-determination data, (2) Structural analyses, (3) Petrographic studies, (4) Distribution of zones of metamorphism. As early as 1942, Dunn and Dey invoked presence of polymetamorphic effects in the Pre-Cambrian terrain of Singhbhum. According to them Dalma volcanics were deposited on the denuded surface of metamorphosed Iron Ore Series of rocks. Out of the Dalma volcanics are themselves converted to epidiorites. So a peak of metamorphism of the Iron Ore Series rocks reaching upto amphibolite facies was followed by another peak of metamorphism reaching at least greenschist facies with considerable time gap. Later workers seem not to have attached sufficient importance to this very important aspect of Singhbhum Geology. The author adds to the conclusion of Dunn and Dey that superposed metamorphism reached upto amphibolite facies in the precambrian tract bounded by the Great boundary fault and Dalma overthrust. The Kuilapal granite is a mantled gneiss dome bearing imprint of more than one orogeny. The basic bodies are arranged in the structural planes of the old granite. Again the granite has been paligenetically eruptive into the basic bodies and has sent veins and epophyses into them and older gneiss. Even this palingenetic granite and its mantle are traversed by a number of crush surfaces in which occurs 'pseudotachylite' or 'flinty crush rock' believed to be product of remelting of the rocks due to heat generated by mechanical rushing. The outcrops of pegmatoid Chhendapathar and Chapri granites bearing no imprint of penetrative structures are aligned along a hidden overthrust zone. Tungsten-copper mineralisation is definitely related to this overthrust zone and also to these late to post tectonic granites. Along the overthrust zone and contacts of the granites large crystal aggregates of andalusite and sillimanite are available definitely indicating thermal metamorphism superposed on regionally metamorphosed rocks.

In Singhbhum and adjacent areas, metamorphic cycles would be more clearly understood as tectonic history of the terrain is more clearly brought out by structural and petrographic analyses and age-delemination data. At present we can decipher at least two tectonic cycles and should expect larger number of superposed metamorphisms.

11. The geology and petrology of the Khasi Greenstones near Shillong, K & J Hills, Assam.

J. M. CHOUDHURY, Gauhati.

The Khasi Greenstones form a distinct rock type in the Archaean Complex of the Shillong Plateau. They outcrop as narrow dykes or irregular bosses cutting across the Shillong quartzites. In general Khasi Greenstones are fine to medium grained rocks with dark green to black amphiboles and grey feldspathic interstitial matter. The hornblendes are bluish green occurring as big poikiloblastic plates enclosing other crystals. The feldspars are andesinic and are highly altered. Epidote, zoisite, ilmenite, sphene and magnetite etc. are the accessories. Sometimes palimpsest structures indicating former presence of titaniferous pyroxenes are shown by the ilmenite and magnetite grains. In general, the texture is granoblastic. Structurally and texturally, the Greenstones are found to be quite different from the amphibolites and the hornblende-schists which occur in other parts of the Archaean complex. They still retain much of the textures of the original plutonic rock from which they are derived. It is concluded that the Greenstones were derived from basic igneous rocks of gabbroic composition and had undergone regional metamorphism along with the quartzites of the Shillong Series prior to the intrusion of the Mylliem granite. The mineralogy indicates that the Greenstones belong to the Aphibolite facies. The field relations and structural evidences show that the rocks belong to Middle Dharwar age.

12. A note on the occurrence of amphibolite around Gurio in the northern vicinity of Tilaiya Reservoir, Bihar.

R. C. MISHRA, Patna.

The paper gives an account of the mineralogy and occurrence of amphibolite in the northern vicinity of Tilaiya reservoid around Gurio. It is a coarse grained greenish looking melanocratic rock composed mostly of amphiboles which possess radiating structure even in hand specimen. The study of the thin section reveals that it is a plagioclase amphibolite rock composed mostly of pale green actinolite and plagioclase plus a little epidote and magnetite and biotite. The paucity of mica has caused absence of visible schistosity in hand specimen. The above mineralogical character of the rock is indicative of igneous parentage. The rock as a whole contains the typical assemblage of minerals so as to be placed in the amphibolite facies.

13. A study of the sedimentation phenomena in the south-west coast of India.

K. M. V. JAYARAM and R. KRISHNASWAMY, New Delhi.

The western coast of Kerala was studied in some detail with regard to sea currents and winds, and with regard to mineralization at various points along the beach and in the sea bed. The data collected indicate the following trends.

1. The rivers flowing west from the western ghats (which form the watershed of the peninsula) do not carry the sediments to the sea due to the formation of the bars at the outlets as a result of sea currents and monsoon winds.

2. 44% of the winds coming from North and North-West result in a erosion of the South-Western parts of the beach to an extent of 15′ per annum. To the north the wind rose changes.

3. A study of the sediments of the sea and the beach prove that the enrichment of the heavy minerals due to sea action is 7 to 8. The size analysis of the

sediments on the beach and the sea indicates no noticeable variation. This, contrary to the present belief, together with the fact that the ilmenites derived from the sea show the same degree of rounding off of the edges and leucoxination, indicates that there is very little, if at all, of fresh addition to the sea bed from the original sources. There is only a constant making and remaking of the coast line.

4. A study of the wind roses, sea currents and refraction diagrams prove the existence of a northerly littoral drift. The sedimentation data correlated on a Stereogram prove a mean depositional trend of N 54° E and a littoral drift at N 36° W—along the coast line. The accretion of the bars and the general widening of the sea bottom contours substantiate this view.

14. Sedimentaries and the associated formations in parts of east Godavari district. (Peddapuram-Jaggampeta area).

R. S. SHENOI and M. POORNACHANDRA RAO, Waltair.

The area lying between Lat : 17° 0′ 0″N; 17°12′ 30″N; and Long : 82°0′ 0″E., 82°12′ 30″E; included in the G.T.S. Sheet No. 65 K/4, has been geologically mapped on 1″ to a mile scale. The formations, striking uniformly N.E.-S.W. and dipping at varying angles, are the Khondalites, the Upper Jurassic Gondwanas, the Deccan traps, the Rajahmundries and the recent Eluru River Alluvium (no strike or dip). W. King (1883) expressed a doubt about the Gondwanas (referred as 'Doubtfuls' here) whether they are Gollapillies, Tirupaties or Rajahmundries. The following studies were made to correlate this Doubtful patch and to investigate the environments of sedimentaries.

Size studies show that (1) the Doubtfuls as well as the Rajahmundries are well sorted ('So' values 1·702 and 1·511), but the latter are better sorted; (2) both sediments are coarse grained, the Rajahmundries being comparatively finer; and (3) both are composed of well sorted mixtures of particles of diverse source rocks. The presence of 93% of Rajahmundry and 73% of Doubtful grains having sphericity values more than 0·65, indicates the higher spherical nature of the former. The lower average elongation quotient value, 1·615, of the Rajahmundries compared to 1·961 for the Doubtfuls, imply the more equi-dimensional nature of the metamorphic quartz in the former. The above two factors testify that both the sedimentaries have the Archean metamorphic suite of rocks as their common provenance. In the case of younger Rajahmundries, there is addition of material from the Doubtful sediments and the Deccan traps. These facts are further borne out by (1) the presence of undulatory detrital quartz grains (metamorphic provenance); (2) the similar heavy mineral assemblages in both the sedimentaries; and (3) the pink to red pigmentation of Rajahmundries (28·8% of iron) compared to the felspathic brown colour of the Doubtfuls (5·2% of iron), contributed mostly by traps in the former case. The pitted garnets in the Doubtfuls and an enhancement in the heavies of the Rajahmundries warrant the efficacy of the intrastratal solutions and diversification of the provenance respectively.

From a comparison of the general characteristics and consideration of the environmental factors, such as the presence of kaolinised felspar in the doubtfuls; the highly oxidising nature of Rajahmundry environment as evidenced by the red beds; and other maturity factors listed earlier, it is surmised that the former were deposited in freshwater, and the latter in transitional environment. It is concluded that the Doubtfuls and the Rajahmundries of the area are distinct from one another, and upper Gondwana age can be assigned to the former.

15. Study of variegated clays occurring in the Gondwana succession in Kanhan Valley of Chhindwara distrist (M.P.).

R. T. SHUKLA, Udaipur.

During the course of investigations in Kanhan Valley of Chhindwara District, M.P., author came across some interesting observations regarding the occurrence of variegated clays. These are found ubiquitously in all the horizons of Lower Gondwana formations comprising Talchirs, Barakars, and Moturs overlain by trap. These clays are of white, red, green brown and chocolate colour and are lined up with limestone nodules. They frequently contain kernels of altered trap. They are devoid of fossils or any organic remains. The clays are lenticular and are of variable thickness. They are intercalated with Gondwana sandstones and occupy the bedding planes of the former. Their field characters backed up by laboratory investigations, reveal that they have probable genetic relationship with trappean material, and have no climatic significance as asserted by previous workers in the area. References from literature from India and abroad have been given in support of this working hypothesis.

16. Characteristics of tropical weathering of the rocks of iron ore stage, Patmunda-Koira region, Bonai subdivision, Orissa.

NIRENDRA BHAUMIK, Jadavpur.

This is a tropical region with high topography, 2,000 ft. on an average with dry hot, moist hot, humid, and cooler climate inculcating in the weathering solution a very specific acidity, alkalinity and redox potential characteristic of that particular season and hence produce differential weathering.

Geologically, the area is an Archaean terrain comprising the Iron Ore Stage of the I.O. Series—the shales (argillaceous, arenaceous and tuffaceous) and banded iron formation (B.H.J., B.M.Q., Quartzites and cherts).

It has been noticed that the chemical composition of the rock largely determine the weathering characteristics of iron and silicon and the composition of weathering solution. Rock texture as porosity, permeability also exerts important influence.

Large scale silicification in arenaceous rocks, including that of shale, pure iron concretions of fine crystalline as well as amorphous goethite in argillaceous shales, formation of Fe, Ca carbonate around Fe nuclei in iron formations are important features. Rocks between argillaceous to sandy ferruginous shales and quartzites are invaded by fine reticulate venation of seams of membranous goethite, sandwitched, inbetween are cryptocrystalline fine powdered silica. The separation of Fe and Si from a composite solution is suggested to be due to dialysis.

Apart from bulbuous swellings and mamillary features Mn bearing tuffaceous shales exhibit a centrifugal tendency of Fe and Mn contained within.

(iii) Economic Geology

17. Ore minerals in ultra basic rocks.

J. S. R. KRISHNA RAO, Waltair.

More than about 250 Ultrabasic rocks from various parts of the world were examined Ore-microscopically for their common Ore-minerals. While most of these rocks are barren of any ore-minerals; some have economically workable chromite

A few of these contain sulphides of nickel like pentalandite and some Pyrrhotite of no economic value. During the process of metamorphism and alteration secondary minerals like awaruite, pyrite, magnetite, gntheite, limonite appear.

This study leads to the following facts : (1) Ultrabasic-rocks which contain ferromagnesian minerals are essentially devoid of any striking mineralization. (2) Chromite is the only workable ore mineral. (3) Rarely as in Sudbary, nickle-sulphides segregate. (4) During the process of serpentinzation most of the iron released appears in the form of late magnetite. (5) If the silicates and sulphides of the Ultrabasics are nickel bearing under appropriate environmental conditions (Oxidation or reduction) they give rise to nickel iron (Ni_2Fe).

18. Paragenesis of awaruite.

J. S. R. KRISHNA RAO, Waltair.

The author has studied the paragenesis of awaruite during his stay in 'Mineralogisch und Petrographisches' Institute of Heidelberg, West Germany under the inspiring guidance of Prof. Paul Ramdohr and Prof. Arno Schüller. The study is based mainly on ore-microscopic methods substantiated by synthesis and X-ray analysis of the mineral awaruite. It suggests :—

(1) that awaruite is not orthomagmatic as it was suggested in many classical text books on ore-mineralogy and mineral deposits.

(2) that awaruite is not genetically related even to the late magmatic processes.

(3) that awaruite is essentially a secondary mineral formed by the reduction of nickel sulphides. The possibility of its origin due to nickel bearing silicates is not ruled out. The study also brings out that most of the *recent ophioliths* are the home of awruite. The study further leads to the discovery of new localities. The new localities are :—

Jackson City, N. Carolina, Br. Columbia.
Elba, Virginia, U.S.A.
Philadelphia, Pennsylvania, U.S.A.
Turin, Italy, Terradifonohetts, Bolognia, Italy.
Blörke, Geraquamotal, Italy.
Wedessos, Austria.
Bogsan, on Berzava river, Banat, Hungary.

19. Hypogene dispersion of copper in the vicinity of lodes in Rajdah area, Singhbhum district, Bihar and its relation to the secondary dispersion.

S. K. BOSE and J. G. K. MURTY, Calcutta.

Experimental sampling of the rocks near the old workings and the suspected mineralised zones was done in Rajdah area to test the hypogene dispersion of copper in the vicinity of lodes and to find out the possibility of locating blind ore bodies underground. About 2000 feet strike length of the Rajdah lode was prospected by sampling of the rock chips and collection of soil samples (9 and 15 inches depth) across the strike of the rock formations/suspected mineralised zones. The dispersion pattern in soil and rocks is very interesting, the details of which are given in a table form.

The rock types are mainly quartz chlorite schist and quartz sericite schist with disseminated magnetite and traversed by quartz veinlets. The primary halos vary in range from 50 to 2000 P.P.M. of copper whereas the soil samples are within 75 to 500 P.P.M.

In one of the line rock values show 250 P.P.M. of copper against 500 P.P.M. of copper in soils at a distance of 200 feet from the lode towards the hanging wall side. It is also observed that up to 260 feet towards the footwall of the first line of working, copper dispersion in rocks has taken place, though the values have diminished considerably. Here, the values in rocks and soils are almost identical. In one of the suspected mineralised zones, the copper values in the rock samples are much more pronounced than those of soil samples and in some cases almost double. In another line the rock values show two abnormal 'Highs' of 1500 and 2000 P.P.M. of copper compared to 75 and 175 P.P.M. in soils respectively. Dispersion halos in the rocks appear to be 'leakage halos'.

Deeper soil sampling and closer spacing of the rock sampling will be helpful to confirm the values already obtained which suggest the existence of a rich zone, may be of limited extent.

20. A note on the copper mineralization of Kolihan section of the Khetri copper belt, Rajasthan.

O. P. VARMA and K. C. PATNI, Dhanbad.

The Khetri copper belt comprises a mineralized zone of about 16 miles in length lying between the towns of Singhana (28° 6′, 75° 54′) and Babai (27° 53′, 75° 49′) in the Jhunjhunu district of Rajasthan. This paper incorporates the results of investigations of Kolihan copper deposits.

The area around Kolihan ridge is composed largely of metamorphosed sediments of Alwar-Ajabgarh series of the Delhi System, repeatedly folded into isoclinal anticlines and synclines, and which consist of highly jointed quartzites, chlorite-actinolite-tremolite schists, mica-schists and phyllites (with or without andalusite), generally with a N25°E to N45°E trend and northwesterly dip between 30° to 35°. Sills of amphibolite and a large number of scattered sills and dykes of epidiorite occur in the Alwar sediments of the area. The Erinpura granite intrudes the Delhi rocks, while quartz veins, cutting all the earlier formations, are abundantly scattered throughout the area in a haphazard manner. Many of them with metallic mineral matter are well-developed near the mineralised zones. All the igneous rocks of the locality are post-Delhi in age.

The core of the mineralized zone, which extends over a length of about ¾ mile, with a maximum width of 50 ft. comprises a system of fracture-filled linked ore-veins, flanked by disseminated sulphides in the brecciated wallrock. Faults seem to have acted as feeder channels, and shear fractures and foliation planes as ore receptacles. The accompanying rock alteration by chloritization, sericitization and to a less degree by biotitization is intense in the vicinity of copper orebodies. Marked feature of wallrock is the development of garnet, andalusite and chiastolite crystals and of feathery amphibole in the Chandmari group of old workings.

The primary sulphide ore consists of chalcopyrite, pyrrhotite, pyrite, marcasite, arsenopyrite together with malachite and azurite as oxidation products of primary copper minerals. The deposits are characterized by abundance of magnetite. Introduced gangue minerals are quartz, chlorite, sericite, calcite, tremolite, garnet etc.

The deposits represent high-temperature hydrothermal replacements. The mineralizing solutions were probably derived from the pre-mineral intrusion of Erinpura granite.

21. Some new occurrences of Galena from Palamau district, Bihar.

G. K. MODAK, Calcutta.

The author records for the first time occurrences of Galena near Singhitali and Hendea (Baitri) in the area around Bhaunathpur, Palamau district, Bihar. The area lies in topo sheets $63^{p}/11$ and $63^{p}/7$.

At Singhitali, Galena is found to occur as thin stringers, patches and also as specks in association with quartz and copper ores (Chalcopyrites and Malachite) in compact, grey, jointed, impure fine grained quartzites and silicified rocks probably belonging to the Lower Vindhyan (?).

About one mile SE of Hendea (Baitri) Galena occurs in a east-west striking mineralised zone (700'×60', maximum width being 80') composed of yellow and brown ferruginous limonitic gossan showing box structure, consisting of a number of more or less parallel and also a few intersecting thin iron-stained quartz veins, in association with a limestone-sandstone sequence. Some of these quartz veins may also be barren. The length of the quartz vein varies from four inches to 10 feet, and the width from about half inch to six inches. The principal ore mineral is galena associated with specks and patches of copper ores (chalcopyrite altered to malachite) and the gangue minerals are quartz (both massive and crystalline) and limonite.

In polished sections galena, covellite and quartz have been identified.

A few samples of galena were analysed for its Pb (Lead) contents. Values ranged between 9 and 75%

The galena deposit of Hendea (Baitri) appears to be promising and merits further attention. The areas around Bhaunathpur requires geophysical and geochemical prospecting for lead mineralisation.

22. The Degana Wolframite deposit, Nagaur district, Rajasthan.

Z. M. MOGRI and O. P. VERMA, Dhanbad.

A study was made of Wolframite-bearing hydrothermal quartz veins in a locality near Rewat Village. Preliminary investigations reveal the following results :—

The formations include pre-Cambrian schists of the Aravalli System, intruded by granitic rocks, and recent sand and gravel beds. The granite has produced pronounced effects of thermal metamorphism on schists. Three prevalent directions of joint systems in the granite are noted : (i) N60°W to N70°W, (ii) another NNW, and (iii) less prominent roughly E-W.

Innumerable veins and stringers of quartz traverse the rock formations. Quartz bodies are of two types (i) barren, (ii) minearlized. They occur in granite, in schists or at granite-schist contacts, ranging in thickness from a few inches to about 2 ft. with NW-SE to NNE-SSW trend. Most of them are vertical or dip towards west, locally being characterised by banded structure formed by alternating layers of mica and quartz. Wolframite is devoid of such banding, nor does it show preference to any particular type of bands. On the other hand it occurs in small veinlets cutting across quartz and muscovite layers. There is no marked difference in the mineralogical composition of the veins except that the ones in schist and at or near granite-schist contacts contain greater amount of topaz.

The ore bodies are (a) mineralized granite, (b) veins and irregular aggregates of quartz, and (c) gravel bed containing lumps and fines of wolframite with boulders and pebbles of granite cemented with sand and clayey matrix. Greater concentration of the ore is found in veins rich in mica traversing dark granite.

Locally, wolframite is considerably oxidised into ferritungstite and tungstite which, in their pale brown to dark brown colour, fill the intergranular spaces. Other ore minerals such as chalcopyrite, pyrite and bornite, which were not visible on the surface, were observed in the cores from drill hole No. 1. Since the drill cores containing those sulphides were not available to the authors, the paragenesis of ore minerals could not be made out. However, the probable paragenetic sequence of other minerals in the veins appears to be muscovite, quartz, wolframite, quartz and orthoclase, fluorite, topaz and the late quartz.

The deposits display a close connection with the granite intrusive from which emanated the wave of hydrothermal solutions that filled the cracks and fractures in the granite as well as in the country rocks.

23. Vanadium in the Dhalbhumgarh sub-division, Singhbhum district, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

The paper deals with the economics of vanadium in titanium bearing vanadiferous magnetite ore occurring between the parallels 22° 21′-23′N. and 86° 30′-35′E., and 22° 23′-33′N. and 86° 15′-21′E. in the Dhalbhumgarh sub-division, Singhbhum district, Bihar. The magnetite ores occur associated with either altered basic (gabbro and dolerites) or ultrabasic (peridotites, pyroxenites and eustatites) rocks which appear originally to intrude into the Iron-ore Series represented either by Phyllites, schists or quartzites in thirteen localities. In most of the areas scree, even weighing up to 16-20 pounds, are noticed along the slopes of the hills. Apart from these, they occur in form of either veins, lenses or segregated materials. The fresh ore is always back, shining with metallic lustre and highly magnetic, where much altered to hematite or limonite it shows dull lustre and becomes feebly magnetic. The minerals found within magnetite are ilmenite, hematite, replacing magnetite, martite, and maghemite formed due to oxidation.

Considering only 0·75 per cent and above of vanadium to be the economically workable limit for vanadiferous magnetite ore, the deposits at Dublabera, Lango and Dhengam appear to be important. At the other places the vanadium content in the ores varies between traces to 0·64 per cent. The average vanadium content at Dublabera area is 1·10, at Lango 1·12 and at Dhengam 0·56 per cent. The total quantity of vanadium available from the ores in these areas, respectively, are of the order of 7,546, 2,837 and 1,000 tons up to a depth of 100 feet (or 30 metres). The estimation of reserves in these localities is also based on the observation of some old and new workings.

All these three areas form one unit as they lie within a distance of about one mile (or 1·6 km.) from each of them. They are connected by *Kutcha* motorable road to Haludpukur railway station lying about 20 miles away and gross quantity of vanadium available in the area is about 11,400 tons.

These ores also contain 10·0 to 16·25 per cent of TiO_2 which has also to be separated for the extraction of vanadium. A suitable methods of beneficiation will however, have to be evolved for facilitating the extraction of vanadium from such ores.

24. A study of Magnesite and its origin in Almora district, U.P.

V. S. DUBEY and P. C. DIXIT, Varanasi.

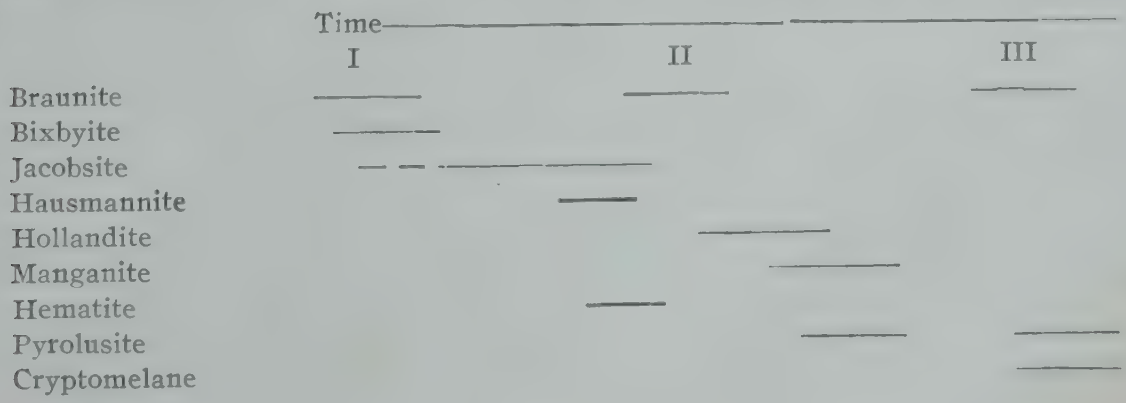
The paper gives the result of the study of the Magnesite deposits in Almora District, U.P. These deposits are invariably associated with Dolomitic Limestone supposed to belong to Krol Series where it has been intruded by the basic sills and dykes and covered by the Tal Quartzites or Slates. In majority of cases the Magnesite is found intimately associated with the deposits of Talc and at times interbedded with it. The deposits extend up to several hundred feet from the basic sills and dykes both in vertical and horizontal directions. The occurrence of Talc is exactly similar to that in Rajasthan, except that the Magnesite has developed here on a much larger scale than in Rajasthan. The minerals Magnesite and Talc seem to have been formed by the action of carbonated waters together with siliceous solutions emanating from the magma supplying the material for basic sills and dykes. The carbonated waters have dissolved away Calcium Carbonate leaving Magnesium Carbonate while action of siliceous solutions on Magnesium Carbonate has given rise to Talc and has turned the basic dykes and sills into Chlorite-Schist at the margin as is seen in Rajasthan also. The presence of these deposits near the upper horizon of the Dolomitic Limestone can be explained by the fact that the fluids emanating from the basic magma could not escape higher up due to the presence of impervious quartzites of Talc and Slates and spread laterally and downward replacing Dolomitic Limestone hydrothermally. At places transition of Dolomite into Magnesite and Talc can be seen clearly in the field and in some cases in the same specimen. Thus the field study completely rules out the direct sedimentary origin of these deposits.

Each deposit is not very big but it is possible that the total tonnage of Magnesite in the District may very well range in the order of several millions. Several deposits are capable of being exploited commercially and are connected by the road to the Railhead, average distance being hundred miles. At a suitable site in the District a hundred ton capacity Calcined-Magnesite-Plant can safely be installed. It is calculated that if calcined on the spot in an Oil-fired Rotatory Kiln, the calcined material may cost about Rs. 200/- per ton delivered in Bengal and Bihar at the site of Steel Industry. Although the percentage of MgO goes up to 45 p.c., the grades are different and prior to the use in Refractory Industry the picking and assorting will be necessary.

25. Manganese ore deposits of Sitapar-Kachidhana mine-area, Madhya Pradesh—A mineralogical and genetic study.

SUPRIYA ROY AND D. R. NANDY, Jadavpur.

Manganese ore deposits of Kachidhana, Sitapur and Gaimukh, Chhindwara Dt., Madhya Pradesh, occur interbedded with gondite, garnetiferous quartzite and feldspathic mica schists and are cofolded indicating syngenetic sedimentary nature. The rocks, along with the ore bodies, were regionally metamorphosed subsequently. The maximum temperature attained during metamorphism was around 500°C as indicate by quart-albite-epidote-almandine subfacies in the feldspathic mica schists. The paragenesis of the ore minerals for the whole area has been determined as follows :



It is evident that the manganese ore bodies were originally laid down as sediments (principally MnO_2), which on metamorphism converted to the lower oxides like braunite and bixbyite and ultimately to metastable vredenburgite at the peak. Hausmannite exsolved in vredenburgite at the waning stage followed by transformation to bixbyite to second generation braunite and formation of hollandite, manganite and pyrolusite respectively. A peculiar observation was made that third generation braunite veins euhedral pyrolusites along and across the cleavages. Cryptomelane and second generation pyrolusite are entirely secondary. While the maximum temperature of 500°C attained during metamorphism can explain easily the formation of bixbyite, it is rather low for the formation of metastable vredenburgite. It is assumed, therefore, that the PO_2 was low enough to depress the transformation temperature of all the manganese oxide minerals and after the formation of euhedral pyrolusite a sudden lowering of PO_2 is postulated, which explains the formation of 3rd generation braunite.

26. Genesis of the Manganese ore bodies of Chikla-Sitasaongi area, Bhandara district, Maharashtra.

SUPRIYA ROY and FANINDRA NATH MITRA, Jadavpur.

The manganese orebodies of Chikla-Sitasaongi area occur at the contact of Sitasaongi and Mansar formations of Sausar Series. The orebodies are interbanded with gondites containing varying amount of rhodonite and are enclosed by peletic schists with which they are always conformable and cofolded into tightly pressed isoclinal folds. The field relations indicate that the manganese orebodies belonged originally to the same sedimentary sequence as the enclosing schists and subsequently suffered the same degree of metamorphism together. The different grades of progressive metamorphism in the peletic rocks such as biotite zone, garnet zone, staurolite zone and kyanite zone have been delineated in the field and thus the maximum temperature attained correspond to 600°C to 700°C. The paragenesis of the ore minerals from the whole area has been determined as follows: braunite I, bixbyite, vredenburgite, braunite II, hollandite, magnetite, pyrolusite and cryptomelane. The texture of the ores varies from schistose to recrystallised coarse gneissose according to the degree of metamorphism and the high temperature assemblages of ore minerals correspond to their peletic schist equivalents in the field. It is concluded that the manganese sediments as MnO_2, with the onset of metamorphism, converted to the Mn_2O_3 form and combined with silica and iron to form braunite and bixbyite. With highering of temperature near the peak, metastable vredenburgite and one-phase jacobsite formed at a temperature between 500° to 700°C (Mason, 1943). This value obtained by Mason from phase-equilibrium studies agrees well with the temperature attained by peletic schists. In the waning stage hausmannite exsolved in vredenburgite, followed by transformation of bixbyite to braunite and formation of hollandite and manganite respectively. Pyrolusite and cryptomelane are entirely secondary.

27. Mineralogy of the Manganese ores of Srikakulam district.

J. S. R. KRISHNA RAO, Waltair.

This paper describes the physical, optical and X-ray analysis of typical manganese minerals from Srikakulam district. The minerals are garnets (spessartites as well as spandites) rhodonite, manganiferous diopsides, Bustamites, Jacobsites, Braunite, Vredenbergite, Pyrolusite, Psilomelane (Hollandite, cryptomalene) and Bixybite. The associated minerals are haematite and magnetite.

Subsequent to the formation of manganese ores, mineralization of insignificant nature is known as revealed by the presence of Pyrite, magnetite, Ilmenite and Molybdenite.

The type areas Koduru, Ramabhadrapuram, Chintalavalasa were critically reexamined for the validity of "Kodurites" as manganese intrusives but the cummulative mineralogical evidence favours otherwise of an originally impure, manganiferous sediment metamorphosed. The study brings out that 'Kodurite's is essentially a high grade metamorphic-rock.

28. The economics of the Limestone and Calc-tufa deposits of Hazaribagh district, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

The author investigated the limestone and calc-tufa deposits in twenty-two localities covering the thanas of Hunterganj, Barkagaon, Ramgarh, Gola, Gomia and Mandu in the Hazaribagh district, Bihar. Limestones are mostly associated with the bands of phyllites or with the calc-silicate rocks. They dip either at moderate or steep angles. Except at two places the limestones are of crystalline variety with either white, greyish white with or without greenish tinge, grey, dark grey, dark or greyish white with yellowish bands. They occur either as veins, lenticular patches or in bands. Individual bands on the average are 2 to 5 feet (or 0·6 to 1·5 metres) thick. The largest of the limestone occurrences is that of Bachra-Hosir which is about 2 miles (or 3·2 kms.) long nearly east-west and extends on either end into Ranchi district.

The following deposits of limestone forming different units appear to be of possible economic importance and can be exploited for cement making :—

Unit No. A	(1) Bachra	4,213,000 tons
,, B	(1) Baskudra-Suiyudih (2) Bundu-Basaria (3) Kurkuta-Religara	13,760,000 tons, of which No. (2) and (3) have a reserve of 7,040,000 and 6,000,000 tons, respectively.

The additional reserves of 3,43,900 tons taken together from Deoria, Chikor, Kori and Ladi can constitute additional reserves for the deposits in unit No. B.

Unit No. C	(1) Ghangrijaratoli (2) Korambe (3) Sondimira (4) Upar Barga	3,238,700 tons, of these No. 1 and 3 themselves have a reserve of 2,933,200 tons.

The reserves have been assumed upto a depth varying between 20 to 100 feet (or 6 to 30 metres).

Taking all the above units together, the results of the chemical analyses of limestones are as follows :—

	CaCo3	MgO	R2O3	Insolubles
Maximum	86·45%	1·45%	1·19%	26·28%
Minimum	73·23%	0·30%	0·40%	11·14%

It may be noted that the above groupings are only tentative and a more detailed examination of the deposits with close sampling will be required before making any attempt at exploration or before any scheme is proposed for setting up a cement plant.

29. A study of the red shales of Bichagatia and surrounding areas in north Cuttack district, Orissa and its suitability as a natural mineral pigment.

KUMAR BANERJEE, Jadavpur.

The red shales intimately associated with the iron ores of Bichagatia (21°56′ :85°56′30″) and surrounding areas belong to the iron ore stage of the Iron Ore Series.

It attracted the notice of the author particularly due to its warm iron red hue and attention was further focussed on its probable usefulness as natural mineral pigment.

After careful study of the material in the field it appeared that most of the argillaceous shales lay within the faulted zone of the area.

The physical properties of the shales were studied with particular stress on colour and particle size. A general observation was made to test its tinting strength, oil suspension and emulsion capacities, hiding power, opacity and mass colour.

The chemical analysis indicated an average of 41%—50% Fe_2O_3; 15%—25% SiO_2; 20%—40% Al_2O_3. No accompanying colour ingredients were detected. The study indicated that the shales were reasonably suitable as a natural mineral pigment.

30. A contribution to the problem of genesis of 'Blue Dust' in the sedimentary iron ores of Bihar and Orissa.

ASOKE CHATTERJEE, Jadavpur.

Samples of 'blue dust' were collected from the Noamundi Iron Ore Mines (22°8′N and 85°30′E) and also from several other iron ore mines in Bihar and Orissa. The powdery variety of iron ore is generally blue-black in colour and hence the terminology. Chemical analysis of the samples placed the Fe-content of the ore between 65 and 70 per cent. In the identification of the ore minerals, physical properties like streak, hardness, specific gravity and magnetism were more useful than the optical properties. Study of the ore minerals in reflected polarized light was not easy due to the difficulty encountered in preparing polished sections. Hematite, being the major constituent of the ore, is associated with varying proportion of martite. The individual crystals are mostly perfect in themselves; but they do not have any mutual coherence and hence the extreme friability of the substance.

Detailed laboratory experiments were carried out on the problems of solution, precipitation and dehydration of iron oxides. On these experimental evidences, supported by field evidences, it is considered reasonable to describe the present powdery state of the substances as the dehydrated residue of a parent hydrate phase. It may be assumed that dehydration of the parent hydrate crystal gave rise to a dehydrated ionic network. The structure being unstable underwent rearrangement to give a new phase.

A further rearrangement may occur in this disorganized material giving crystalline nuclei of still another phase. The process is accelerated in the presence of water vapour.

31. A note on the petrological characters and their significance of coals from Umaria, Madhya Pradesh.

BANKIM MUKHERJEE and KAMAL CHAKRAVARTY, Jadavpur.

Coal seams around Umaria (Lat. 23°31′ and Long. 80°50′), Madhya Pradesh, occur in Barakar formation. There are six seams of which two are worked, others are of poor quality.

Channel samples of coal, collected from the working seams II and III were subjected to chemical and petrological analyses under carefully controlled conditions. The quantitative petrological analysis was expressed in terms of three group macerals—vitrinite, exinite (including resinite) and inertinite (fusinite, semifusinite and micrinite). The average of several analyses are given in the table below :

	Proximate Analysis.					Petrological Analysis			
	Moisture %	Volatile matter %	Fixed Carbon %	Ash %	Caking or non-caking	Vitrinite %	Exinite %	Inertinite %	Visible mineral matter %
Seam II	2·66	13·45	54·73	28·65	Non-caking	31·39	17·26	36·16	14·89
Seam III	10·00	28·78	45·91	15·26	Non-caking	40·93	35·88	20·68	2·50

The quantitative petrological analysis which exhibit both inter- and intra-seam variations were subjected to statistical analysis on methods of Snedecor (1946) to see whether these variations were inherent or not. Contingency chi-square test was also applied since the distribution was discrete. The general conclusions arrived at are (1) The difference in the composition of the two seams depends mainly on their exinite and inertinite contents, (2) Inherant variation in seam II is attributable to the exinite content, and is brought about by igneous intrusion, (3) High inertinite and low exinite content and the presence of vitrinites of higher reflectivity reveal the fact that seam II has been affected by igneous intrusion, (4) Low exinite content seem to be responsible for the low volatile matter content of seam II and reverse applies to seam III which is normal coal, (5) Non-caking characters of these coals are due to the absence of the typical type of vitrinite influencing caking.

32. A note on the geochemical prospecting for copper between Turukocha and Nandup, Singhbhum copper belt, Bihar.

S. K. BOSE and J. G. K. MURTY, Calcutta.

The paper deals with the results of the reconnaissance geochemical soil sampling which was carried out in a 12½ mile long belt between Turukocha and Nandup during 1957-58 season to delineate potential copper rich .zones.

The area between Rajdah and east of Mandup is occupied by chlorite mica schist, constituting the main rock type of the shear zone, besides the sheared conglomerate bands. The shear zone rock types in this area are characterised by apatite-magnetite mineralisation. The traverses were laid 1,000 feet apart (approx.), across the strike of the rock formations in the mineralised shear zone of the belt and the samples collected from an average depth of 9 inches below the humus zone at 25/50 feet interval. The copper values in soil samples varied from 50 to more than 4000 P.P.M. against the background of 50-100 P.P.M. The width of the anomaly zones varied from 50 to 350 feet. Few samples collected from deeper depths (15 inches) gave more encouraging results and appeared to be more reliable, specially from areas with thicker soil cover. Some of the samples showing high copper content were analysed for nickel to be of assistance in shortening the zones of anomaly for copper to narrower limits. The values for nickel range between 50-250 P.P.M. and were seen to correspond to the major peak anomaly zones of copper. The geochemical anomalies bear a close relation to the self potential and magnetic indications.

A study of the geochemical results coupled with geological data suggest that there are two copper rich areas in this part of the belt, viz., at Rajdah and Ramchandra Pahar. In Rajdah area there appears to be only one lode (may not be continuous one) whereas in Ramchandra Pahar area there are three principal lines of old workings which are quite extensive and appear to suggest the existence of at least three lodes, the extent of which is not known at present.

33. Fossil Ostrea from the Dwarika Beds of Gujerat State.

B. NATH, Patna.

In a visit to Dwarika, in October, 1960, the author came across a fossiliferous bed from which about two dozen fossils of *Ostrea* were collected.

From a morphological study, two species of *Ostrea* have been distinguished :

1. Ostrea multicostata and 2. *Ostrea-bellovacensis*.

Dr. Fedden has separated Dwarika beds from the Gaj bed on account of mineral characters and absence of Gaj fossils. But it is of great interest to note that the fossil Ostrea *multicostata* of Gaj bed is found in the Dwarika beds. The other species closely resembles Ostrea bellovacensis of the Upper Ranikot Zone No. 3.

Both the species therefore are of great palaeontological interest.

34. On the Generic classification of some "Orthoceras" from India, Burma and Pakistan.

S. S. SARKAR, Calcutta.

While studying some *Orthoceras* from the Triassics of Kashmir, the author came across a number of incomplete identifications of *Orthoceras* scattered here and there in the GSI palaeontological literatures. These uncertain specific as well as generic determinations are somewhat vexing and the author first of all has made an attempt to classify generically some *'Orthoceras'* figured from India, Burma and Pakistan. Of course, this is the first attempt in this respect and a great hindrance to this end has been that, some important foreign Monographs and publications are not available in the GSI Library or elsewhere in this country and the author had no other alternative but to rely upon some reproduced versions given by some later workers.

The following are the Genera represented and the author has discussed each time in the original paper the points supporting the classification :—

I. *Kionoceras* sp. ind.
=*Orthoceras sp; ind.* Diener, 1915, from Kanaur, Pl. XI fig. 4, Pal. Ind. N.S. Vol. V, Mem. no. 2.

II. *Protocycloceras cyclophorum* Waagen from Salt Range.
=*Orthoceras cyclophorum* Waagen, 1879.
Pl. VI figs. 7 & 8, Pal. Ind. Ser. XIII, Vol. 1.
=*Orthoceras cyclophorum* Waagen
No. fig. page 54, Pal. Ind. N.S. Vol. XVII, F.R.C. Reed, 1931.

III. *Michelinoceras* Foerste, 1932.
1. *Orthoceras regulare* (Schlotheim) *in* F.R.C. Reed, 1917, from Yunnan, Pl. V figs. 13, 13a, Pal. Ind. N.S. Vol. VI, Mem. 3.
2. *Orthoceras cf. scabridum* Angelin from Yunnan, Pl. V fig. 14, Pal. Ind. N.S. Vol. VI, Mem. 3, F.R.C. Reed, 1917.
3. *Orthoceras aff. laterale* Phillips from Northern Shan States, Pl. XVIII, fig. 13, Pal. Ind. N.S. Vol. II, Mem. 5, F.R.C. Reed, 1908.
4. *Orthoceras sp. ind.* from Upper Burma,
Pl. VII fig. 14-Pal. Ind. N.S. Vol. II pt. 3, F.R.C. Reed, 1906.
5. *Orthoceras sp.* from Yunnan, F.R.C. Reed, 1917,
Pl. V fig. 16, Pal. Ind. N.S. Vol. VI, Mem. 3.

IV. *Leurocycloceras* Foerste 1928.
=*Orthoceras oblique-annulatum* Waagen, 1879, from Salt Range,
Pl. VI, figs. 9-10, Pal. Ind. Ser. XIII, Vol. 1.
=Orthoceras cf. annulatum Sowerby ? from Central Himalaya,
Pl. XX fig. 13, Pal. Ind. Ser. XV, Vol. VII, Mem. 2.

V. *Geisonoceras* Hyatt 1884.
=*Orthoceras aff.* eichwaldi Barr. from Burma,
Pl. X figs. 6, 6a-Pal. Ind. N.S. Vol. VI, Mem. 1, F.R.C. Reed, 1915.

VI. *Paracycloceras Gen. nov.* Sarkar.
=*Orthoceras* (*Protocycloceras* ?) *departi*, F.R.C. Reed, 1917,
Pl. V figs. 15-15b, Pal. Ind. N.S. Vol. 6, Mem. 3.

35. The early forms of *Nautilus pompilius* Linne, 1757.

S. S. SARKAR, Calcutta.

The fossil *Nautilus* and the living *Nautilus* establish a link between the Palaeontologists and Neontologists. The living *Nautilus* also throws much light on the fossil Cephalopoda. The author had been interested in tracing the early forms of this living Indian Ocean species from the geology of India and other adjoining countries :

In 1873-76 William Waagen while examining the Jurassic Fauna of Cutch (Pal. Ind. Ser. IX, Vol. 1) discovered a new species—*Nautilus intumescens*, which he remarked, was most nearly allied to the living *N. pompilius* L. The author had examined this species (GSI Type specimen No. 1893) described by Waagen and was struck by the resemblance this Jurassic species showed to the present day *Nautilus*. Waagen had placed this species along with *N. pompilius* L. in the group of *Simplices* of Quenstedt; while *N. pompilius* L. falls under the group of *Laevigati* or *Nautili* in the classification of d'Orbigny adopted and highly recommended by Blanford (1865) while describing the Cretaceous Cephalopoda of South India. As the author has not yet handled *Nautilus* fossils extensively he is not yet in a position to speak on the above two classifications.

The Tertiary species *Nautilus subfleuriausianus* d'Archiac. has got a close resemblance to the present day species of *Nautilus*. The author had examined carefully all the following figures lying under this species: The figures given by Cossman and Pissaro, 1909 (Pl. I, figs. 1-4, Pal. Ind. N.S. Vol. III, Mem. No. 1, pt. 1, GSI Type No. 10,779) have got no resemblance to *N. pompilius* so also the Figs. 1 & 2 of Pl. II of Vredenburg, 1929 (Pl. I figs. 1, 4, Pl. II figs. 1-2; Pal. Ind. N.S. Vol. X, Mem. IV, GSI Type No. 13,209). Out of the four figures, only figs. 3 & 4 in Pl. I of Vredenburg bear a striking resemblance to *N pompilius* L.

A comparative study of the three following forms on the breadth is to length ratio was made and the Fig. 3 (Pl. I of Vredenburg) has almost the same form as that of *N. pompilius* L., besides there is a close resemblance of suture, umbilicus etc. between the two:

1. *N. intumescens* Waagen, 1879 ... ... 77·9 %
2. *Nu. subfleuriausianus* d'Archiac, 1929 (Pl. I fig. 3 of Vredenburg) ... 72·1 %
3. *N. pompilius* Linne, 1757 (Fig. 135, page 305, Woods, 1950) ... 72·06%

36. Human and Vertebrate sutures for specific determination in fossil and living forms.

S. S. SARKAR, Calcutta.

Sutures play a very important role in the Ammonoids. While a group of Invertebrate palaeontologists stress mainly on sutures for specific and generic distinctions, there are other workers who do not agree to that extent and are inclined to give the prime importance on the outer ornamentation and characters. The author wanted to know how the Human Vertebrate sutures reacted in the specific differentiation. So far, some Physical Anthropologists had only been investigating upon—Suture Closure, which might be called on the other hand, the study of the ontogenic variation of suture; to assess the age at death of skulls.

Sutures are immovable lines of junction between the bones of the Human Vertebrate skull and in the Ammonites, it is also the lines of junction of Septum with walls of shell.

As it appears, no attempt has been made before in this field and the author carried some investigations on the Human and Vertebrate Sagittal sutures. He first started from two known Human species—the Sinanthropus skull and the Rhodesian skull. After subdividing them properly into: S1, S2, S3 and S4, he compared them side by side. While the Sinanthropus Verticis, S2 (13 lobes) is simpler in nature, it is of a very complicated pattern in the Rhodesian S2 (8 Lobes) and is also 1 cm. longer than the former. These show clearly that they are not the same species but quite different from each other. The other variations in S1, S3 and S4 have not been discussed here.

The author made another investigation on three skulls from three different Human races, e.g. Chinese, Mediterranean and Bengali (as no good Negro skull could be obtained). This investigation also proved satisfactory as explained by sketches of the Sagittal sutures made direct from the skulls.

As regards fossil or living higher vertebrates (Mammals) no good specimens with preserved Sagittal suture of two related or adjacent species could be obtained for a close comparison. The author tried however, upon some well preserved species of *Macaca* and shows that the results do not speak in the negative.

This is a preliminary attempt on the role of sutures, particularly the Sagittal suture. The author believes that sutures can be of help in this field.

As regards Man, there are at least 50 *Homo* species created. According to Boule and Vallois most of the determinations should fall in synonymy. The author suggests a revision and classification of these 'Species' on the basis of a cranial suture, e.g. Sagittal Suture, as these 'Species' have been erected on some or other physical characters.

37. Assilina from the Eocene Rocks of Garo Hills, Assam.

BIMAL KUMAR SAMANTA, Calcutta.

Eocene rocks of Garo Hills, Assam are made up of Tura, Siju and Kopili formations in ascending order. The sequence is conformable. Assilina occurs only in lower part of the Siju Limestone formation (Middle-Upper Eocene). A thorough study of these Assilina-limestones reveals the presence of following forms : Assilina regularia Ghose emend. Samanta, A. regularia sijuensis n. var., A. subassamica Samanta, A. subassamica sijuensis n. var., A spira corrugata De la Harpe, A. spira taikhamensis n. var. A. subspira De la Harpe, A. subspira corrugata n. var A. simsongi n. sp., A. subsimsongi n. sp., A. exponens Sowerby and A. mamillata D'Archiac.

A study of various species of Assilina described from Middle to Upper Eocene rocks of India and Pakistan shows that they can be classified into two groups on the basis of prominence of marginal cord and rate of opening of spire. Thus A. spira, A. irregularis, A. papillate, A. regularia and their corresponding megalospheric forms differ fom A. exponens, A. rota, A. cancellata and their corresponding megalospheric forms in having prominent marginal cord and rapid rate of opening of spire.

(v) Stratigraphy

38. Revised Stratigraphic Succession of the Iron Ore Series Rocks in South Singhbhum-Keonjhar Region.

S. N. SARKAR, Dhanbad, M. N. MAHAPATRA, New Delhi, and
K. C. SAHU, U.K.

Intensive stratigraphic and structural work in Joda-Gurda-Noamundi region, reconnaissance in the surrounding key areas and reinterpretation of the earlier data have necessitated the following revision of the stratigraphic succession of the Iron Ore Series in this type area. Systematic tectonic analysis show the structure of this series in the region to be a low NE plunging synclinorium, overturned towards SE, and the top and bottom criteria indicate the eastern limb as the normal one

Revised succession

		Newer Dolerite
Kolhan series	...	Kolhan shales Kolhan limestone (impersistent) Kolhan sandstones and conglomerates Unconformity Singhbhum granite
Iron ore series	...	Upper shales and phyllites, sandstone, lavas Banded hematite jasper with iron ore Lower shales, phyllites and tuffs Basal sandstone with conglomerates Unconformity Older Metamorphics : Mica-, sillimanite-, hornblende-, chlorite- and quartz schists.

39. Banded Ferruginous Quartzite near Saundatti.

MISS K. R. GHAISAS, Poona.

This paper contains an account of some bands of banded ferruginous quartzite occurring in the neighbourhood of Saundatti, a Taluqe town in the Belgaum district of Mysore State.

The tract under consideration lies midway between the northern extremeties of the main Dharwar band and the Gadag band.

The following are the Dharwarian rocks occurring around Saundatti, arranged in their order of importance :

(1) Epidiorites and Hornblende schist.
(2) Chlorite-phyllite.
(3) Hornblende-biotite-schist.
(4) Banded ferruginous quartzite.

Banded ferruginous quartzite forms almost a negligible portion of the Dharwarian rocks around Saundatti. Beds of small size were noticed in three places (1) North of the village Gorvankol, (2) About a mile to the north-west of Saundatti close to the east of the Saundatti-Manoli road near the milestone 5/6, (3) the hillock of Saundatti where the drinking water reservoir is built.

The rocks found at all the above places are lithologically similar, and are composed of alternating layers consisting of chiefly of quartz and iron ores such as haematite and magnetite. The beds are not themselves folded, but laminae occurring in some middle portions of the beds are wavy or even crumpled and contorted and many of them are recumbant. The folds or contortions do not exhibit any order and die out near the top and bottom of the beds. But even when wavy or crumpled or recumbant, the laminae maintain their parallelism.

The rocks on the whole are poor in iron, the siliceous portions of the rocks consist of quartzites, fine to coarse grained and with mosaic or sutured textures.

It appears that both the siliceous and accessory minerals were originally detrital material i.e. ordinary sediments coming from the waste of some terrestrial rocks, such as basic lavas, tuffs and sills—which could easily furnish apatite or epidote. The actinolite could have come from sills or other intrusions in which much actinolite was produced in the late or deuteric stages. These evidences show that the rocks owe their origin to sedimentary processes and not to metasomatic or any other processes.

40. Stratigraphic Position of the Shear Zone Rocks to the South of Tatanagar, Singhbhum Dt., Bihar.

A. K. BANERJI, Calcutta.

The shear zone, to the south of Tatanagar, is bounded by two shear planes to the north and south respectively and encloses a group of rocks that vary in thickness from about two miles at the eastern part to about three miles at the western part of the area studied. The shear zone is bounded by the Chaibasa stage of rocks to the north and the Iron Ore stage of rocks to the south. Present studies indicate that the rocks within the shear zone consist of a thin slice of Chaibasa stage rocks to the north and a thin slice of Iron Ore stage rocks to the south. Between these two slices occur a group of rocks that are correlated with the Dhanjori stage. These rocks are separated from the slice of Iron Ore stage rocks by a band of thin but impersistent conglomerates and thus occupy a position stratigraphically similar to the Dhanjori rocks. Moreover these rocks consist of metamorphosed equivalents of shales, sandstones, lavas and conglomerates and are therefore lithologically similar to the Dhanjori rocks. It is suggested that the Dhanjori rocks extend westward beyond Narwa Pahar which is commonly believed to be the western limit of the Dhanjori basin.

41. Geology and mineral resources of the area around Fal Tashil, Surguja District, Madhya Pradesh.

G. K. MODAK, Calcutta.

An area of about 337 square miles between latitudes 23° 32′ 30″ and 24° 0′ and and longitudes 83° 30′ and 83° 44 30″ in parts of Surguja district of Madhya Pradesh was mapped on the scale of one inch to one mile on survey of India topo sheets 64 M-9 and 64 M/10 with a view to locating occurrences of minerals of economic importance.

The area consists of Archaeans, Lower and Upper Gondwanas.

The Archaeans are represented by ancient crystalline gneissose (including various types of granite gneisses) and garnet-staurolite-hornblende bearing schistose rocks and quartzites. Granite gneisses are traversed by innumerous ramifying quartz and pegmatite veins and also by dolerites of all dimensions.

The Lower Gondwanas are represented by the Talchir boulder bed, laminated khaki green or olive green and also pale pink sandstones interbedded with shales or shaly bands and *coal* bearing Barakars made up of sandstones and shales.

The Upper Gondwana rocks of the area are characterised by the Mahadeva (?) sandstones forming prominent hill masses and hill ranges.

The boundary between the Archaeans and Gondwanas appear to be a faulted one (?) as also the boundary between the Barakars and the Mahadeva.

There are several coal seams of low grade and inferior quality. There are also a number of Hot Sulphur Springs (about 23 in number) recorded in a fault zone in the neighbourhood of Tattapani (23° 41′ : 83° 40′), about ten miles south of Ramanuj Ganj (23° 48′ : 83° 42′ 30″).

42. Geology and correlation of the Indravati Series of Bastar District, Madhya Pradesh.

N. V. B. S. DUTT, Calcutta.

The paper embodies the geology of the Purana formations of the Bastar district, Madhya Pradesh, and their correlation on lithological, successional and structural considerations with the Kurnools of the type area and the Puranas of Chhattisgarh and the Godavari valley. The Puranas of Bastar present a conformable series, which is designated as the Indravati series after the river draining the major outcrop. Their stratigraphic sequence in ascending order, namely, (1) Tiratgarh subarkose and orthoquartzite, with shales towards the top, (2) Kanger limestone, and (3) Jagdalpur shale and shaly limestone, with calcareous bands in the lower portion and siliceous bands mainly in the upper part, is established.

The Tiratgarh quartzite is correlated with the Paniam, the Kanger with the Koilkuntla, and the Jagdalpur with the Nandyal, of the Kurnool system. They are correlated in the same order with the Chandarpur subarkose, the Charmuria limestone, and the group of Gunderdehi shale, Khairagarh sandstone and Raipur shale and shaly limestone, of Chhattisgarh. The Khairagarh would be represented in Bastar by the siliceous layers intercalated in the lower part of the Jagdalpur formation.

A tentative correlation of the Tiratgarh with the Sullavai and of the Kanger with the Upper (? Sullavai) limestone is suggested. In view of the absence of clear unconformity between the Pakhals and the Sullavais (Heron, 1949), it appears the Pakhal quartzites and the Penganga limestones and shales might be correlated with the Banganapalles and the Jammalamadugus respectively.

43. A reconsideration of the Stratigraphic position of the Chrome-serpentine Rocks of Kankauli and Vagda, Ratnagiri Dist., Maharastra.

PRABIR KUMAR GUHA, Jadavpur.

The ultrabasic intrusives of serpentine containing chromite outcrop at Kankauli (16° 16′, 73° 45′) and Vagda (16° 14′, 73° 45′) in the form of dyke-like bodies. They were first studied by Ghosh (1933), and then by Iyer (1939). Detailed work on these rocks by Chakrabarty and Guha (1960), showed that these rock bodies cut across the foliation of the granite-gneiss of Archaean age. The granite-gneisses are intimately associated, and intrusive into the Dharwarian schists and gneisses. Hence the chrome-serpentine rocks together with the intimately associated Dharwar and Archean system of rocks can definitely be postulated to be pre-Cambrian age.

Iyer (1939), however, in his stratigraphic classification of the region, places the metamorphic rock types, now accepted as Dharwars, in upper Kaladgis (Cuddapah). He has not acknowledged the existence of Dharwars in this tract, which leads him to predict a post-Cuddapah age for the chrome-serpentine rocks.

From detailed investigations in the field, the author feels that the chrome-serpentine rocks, apart from being pre-Cambrian, are also pre-Cuddapah in age.

44. Geology and structure of parts of Visakhapatnam District, Andhra Pradesh.

A. SRIRAMADAS, M. S. MURTY and R. V. RAMARAO, Waltair.

Variation in structural trends from N.W.-S.E. through E.-W. to N.E.-S.W. is noticed during the mapping on four inches to a mile scale of about 30 square miles area located in between latitudes 17° 40′ and 17° 42′ and longitudes 83° 2′ 30″ and 83° 15′ near Gazuvaka in Visakhapatnam District of Andhra Pradesh.

The geological formations met with in the area are the khondalite series consisting of the garnet sillimanite gneisses, the garnetiferous quartzites and the quartzites, the charnockites and the porphyritic feldspar granite gneisses.

The N.W.-S.E. structural trends of the area are parallel to the Mahanadi strike, although the area forms a part of Eastern Ghats which have N.E.-S.W. trend. The presence of plunging folds, drag folds and the criss-cross pattern of the jointing show that the area was subjected to extensive tectonic disturbances.

Studies are in progress to analyse the tectonic forces that affected the area.

45. Geology of the Gollapalli area, with special reference to the Sedimentary formations.

B. B. G. SARMA, CH. V. RAJU and A. V. MURALI, Waltair.

The Gopalli area (northern part of G.T.S. Sheet No. 65 D/14) is the home of Gollapalli sandstones, a stage in the Gondwana system of rocks along the east coast of India. However, since the publication of King's classical memoir (1883), there has not been any detailed work on this area. The present investigation aims at a detailed mapping of the area (16° 39′ : 16° 45′; 80° 49′ : 80° 59′) on a 4″ to a mile scale, followed by sedimentological study of the formations.

The rock units met with are as follows :

Lithology	Local name	GSI classification	Age	Strike	Dip
Conglomerates; unfossiliferous, dark, coarse, ferruginous sandstones	Rajahmundry sandstones	Cuddalore sandstones	Oligocene-Miocene	Horizontal	—
Fossiliferous dark brown sandstones and shaly sandstones	Gollapalli sandstones	Rajamahal	M. Jurassic	N.E.-S.W.	5-10° S.E.
Quartz-garnet-sillimanite gneiss and quartzites	Khondalite	Archaean	Archaean	NNE-SSW	70-80 ESE

The units are separated by conglomerate beds of varying thickness.

Compressions of equisetale stems from the Gollapalli sandstones are found and identified. This constitutes the first report of their occurrence from this area. Similar fossils have been reported earlier (1960) from the Nuzvid area to the north.

The Gollapalli and Rajahmundry sandstones are characterised by the following average values for their median, sorting coefficient and sphericity : 0·28 mm. and 0·478 mm., 1·441 and 1·393, and 0·625 and 0·710. A higher energy level for the depositional environment of the Rajahmundry sandstone is thus indicated. The heavy mineral suites point in general to the khondalite suite of rocks as the provenance. Presence of corroded boundaries for some minerals in the Gollapalli stage, and occurrence of a greater number, as well as some of the unstable species, of heavy minerals like epidote and hornblende in the Rajahmundry standstones, indicate the possible action of intrastratal solutions.

46. A Note on the Cretaceous Rocks of the Western Khasi Hills, Assam.

M. V. A. SASTRY and A. M. KHAN, Calcutta.

The paper deals with the detailed study of the systematic collection of fossils made by the authors from the Upper Cretaceous rocks of the Balat-Gumaghat area of the Western Khasi Hills, Assam. The basal beds constitute massive, coarse, felspathic sandstone with irregular bands of ferruginous sandy shales which are highly fossiliferous. These are conformably overlain by the fossiliferous glauconitic sandstone beds. The study reveals that the Cretaceous beds of this area could be correlated with that of Mahadev stage of the adjoining Thariaghat area. The fauna includes, in addition to already known forms, *Panopea*, *Tellina*, *Pinna* and a few others which are recorded for the first time from the Cretaceous beds of Assam. The following arenaceous foraminifera are also noted. *Haplophragmoides haplophragmoides* Eggeri, *Ammobaculites junceus* Cushman and Applin, *Turritellela* sp., *Spiroplectammina bentonensis* Carman and *S. navarrona* Cushman.

The faunal assemblage suggests a horizon equivalent to that of the Ariyalur stage of South Indian Cretaceous, indicating a Maestrichtian age.

47. An unreported Band of Raghavapuram Shales from Duddukur area, Andhra Pradesh.

B. B. G. SARMA and V. RAMESAM, Waltair.

The Duddukur area (South-western part of G.T.S. Sheet No. 65 G/12) was geologically mapped earlier by King (1880), Venkayya (1947), Appurao (1950), and Krishnan (1951). The formations reported are as follows :

Alluvium ...	... Recent.
Oligocene-Miocene	... Rajahmundry sandstones and conglomerates.
U. Cretaceous & Eocene	... Deccan traps with intertrappeans.
Cretaceous ...	... Infratrappean sandstones and shales.
U. Jurassic ...	... Tirupati sandstones.
M. Jurassic ...	... Gollapalli sandstones.

A recent survey of the area on the scale of 4″ to a mile revealed the presence of a band of shales and clays occurring between the Tirupati sandstones and Gollapalli sandstones, the band roughly running east-west. Outcrops are met with in the village of Yelachintalgudem (17° 6′; 81° 33′ 30″) and half mile north of Peddapuram (17° 6′; 81° 34′ 15″). The shales are variegated in colour, with a maximum thickness of 40′ and dip at 20° S.E. generally. Imperfect leaf impressions are found and identified as belonging to the form genus Taeniopteris. The lithology, fossil content and stratigraphic position leads one to conclude that these shales and clays belong to the Raghavapuram stage of the Gondwana system of rocks.

As the Raghavapuram shales are generally believed to be of marine origin, this report is of significance as it indicates a marine transgression following the continental Gollapalli stage in this area.

(vi) Structure Tectonics

48. Stages of Structural Growth of the Peninsular India.

R. P. SINGH, Patna.

The Central protruding stable landmass of Asia in the Indian Ocean forms the Indian Peninsula. but its build, structural layout and facial expressions eloquently speak about its ancient anchorage with the super-continent of Gondwanaland.

The framework of the Peninsular India can be understood in terms of the attitude of rocks which add to the variety of structural features from horizontality to verticality with reclining posture and from simple wrinkling to magnificient contortions of nappe, pitching anticlines, anticlinorium and synclinorium. The major plans of its making go back to far distant period of diastrophism, effusion and enstatism.

The author outlines the possible stages of its structural development. The structural base of the Peninsular massif is provided by a series of batholithic intrusions of granites, gneisses and charnokites into highly metamorphed Dharwar strata. The Dharwar appears in their denuded state. The Archaean denuded surface, covered with Cuddapah and Vindhyans, is torn in a linear fashion perhaps in sympathy with the Hercynian Revolution where glacio-fluvial, lacustrine detritus found a comfortable corner and is also burried beneath the Cretaceous Rajmahal and Eocene Deccan trap lavas.

The chapter of Jurassic and Cretaceous inroads of seas explains the horizontal structures of Cutch, Trichinopoly, Bagh and Lameta.

The shield registered epeirogenetic reactions in sympathy with the Tertiary Revolution. This finds an expression on its face in the form of uplift tilt, warp, and even depression.

49. Shear emplacement of thin limestone bands along Granite Contact, East of Kharwa (26° 11′ : 74° 26′) Rajasthan.

SUGATA SEN GUPTA, Calcutta.

In this area, Dr. Heron mapped a group of Delhi metasediments in contact with Pre-Aravalli Granite. Here two thin (30′-100′) linear belts of marble are found to intervene between them. All the contacts are sharp and straight. The bands trend N40°E on average, showing a tendency to merge with the main belt of 'Ajabgarh Marble' towards SW from which they are separated by a thin horizon of micaceous quartzite.

The marbles are vertically foliated. The foliation plane is parallel to its lithologic boundary and is extensively developed in all the adjoining rocks as a very good shear cleavage. Very often the quartzites are mylonized and the granite is changed to augen-gneiss or even to ultra mylonites. The thinner quartzite lenses within the marble bands are only fractured and slightly granulated, but where the quartzites dominate, it is converted to an extremely sheared quartz-schist.

The 'Ajabgarh Marbles' to the west of the shear zone often have thin long tongue like projections into the associated micaceous quartzites mainly along these shear cleavages.

The main marble horizon and the linear marble bands are lithologically identical. There is no visible effect of the granite on the marbles though they occur in close contact. These features besides the structures leads to the presumption that the marbles were possibly emplaced as 'cold intrusions' by shear gliding from the 'Ajabgarh' marble. The physical discontinuity between them may be due to the still later shearing along a N-S shear plane which is well developed within the intervening quartzite.

It is interesting to note that the mesoscopic folds and lineations away from these marble bands plunge to NE at moderate angles and the fold style shows a dextral movement whereas in the rocks adjacent to marble bands a SW plunging lineation is developed and if it is the transport axis, the sense of transport is sinistral.

50. Tectonic significance of the presence of more than one set of Lineations in Deformed Rocks.

S. S. MERH, Baroda.

Lineations in deformed rocks indicate important traces of movements and are very useful in deciphering the directions of tectonic transport in areas of deformation. Lineations develop parallel and normal (sometimes oblique also) to the direction of tectonic transport. Deformed rocks very often show two sets of lineations and in this paper the author has discussed the tectonic significance of such cases. First he has briefly described the mode of origin of various linear structures like slickensides, minor folds, mullions, quartz rods, lineations due to stretching and due to cleavage-bedding intersection. Later on he proceeds to discuss the various ways in which rocks develop two sets of lineations. More than one set of lineations in rocks could be due to (i) one single deformation, (ii) two deformations and (iii) several deformations. Even though an area might have undergone more than two phases of deformation, it is very rarely that the rocks at one single spot contain lineations belonging to all the deformations. Depending on the rock types, overall structural pattern and the variations in the intensity of the different episodes in different parts of the ground, from place to place, lineations belonging to different generations might exist in pairs in various combinations, but never exceeding two at one spot. Thus in areas of repeated deformations, the field investigations should, in addition to routine observations of lithological types, boundaries, foliation, cleavage and joints etc., consist mainly of a systematic mapping of linear structures. Subsequent statistical analyses of linear structures and a correlation of the results with other field and laboratory data, leads to a correct understanding of the structural geology of an area.

51. Occurrence of Crush-Breccia in Singhbhum Granite.

AJIT KUMAR SAHA and SHYAMAL KANTI CHAKRABORTI, Calcutta.

An interesting group of brecciated rocks, lying in a north-south trending zone (500 ft. × 250 ft.) has been observed near the village Phuphundi (86°7′ :22°35′) within the Singhbhum granite. The breccia is composed of sharply angular to irregular fragments (from microscopic dimensions upto boulders 2 feet across) of leucogranite, hornblende granodiorite, amphibolite, epidiorite and metagabbro, set in a highly comminuted mylonitic matrix containing quartz, plagioclase, actinolite, chlorite and sericite. The mylonitic ground mass shows schistosity dipping 70°-80° towards east, while the mineral foliation in the adjacent hornblende granodiorite dips 50°—60° towards north-east. Two dykes of unsheared Newer Dolerite cut across the zone of crush-breccia. The groundmass schistosity wraps around the smaller fragments (<1 mm.) and is crumpled against the larger fragments which show frequent marginal granulation. A similar elongated zone of brecciated rocks was found within the granites near Barasai (86°12′ :22°38′).

The elongated bodies of crush-breccia are considered to represent faults in Singhbhum granite. The matrix probably represents mostly granodioritic materials, but parts of it have clearly been incorporated by the crushing of other affected rocks. The generally unsheared nature of the larger fragments is partly explained by assuming that the fault movements occurred at considerable depth below the surface. The large variety of the rock fragments within the breccia probably indicates considerable vertical extent of the fault movements which are obviously of pre-Newer Dolerite age.

52. An Occurrence of Sandstone Dykes in the Upper Gondwanas near Perumber, Chingleput District, Madras State.

Y. K. AGRAWAL and K. V. S. RAM, Dhanbad.

Sandstone dykes, generally uncommon geological features in India, have been observed for the first time in the Sriperumbudur series of beds S.W.S. of Perumber railway station (Topo sheet 57 P/15, 12°22′, N 79°47′E). These are found in the bed of the Ongûr river, west of the road bridge on it. These also extend westwards in their distribution to some 200 yards along the bed of N. Negungal river and S. Nedungal river. These exposures are continuous in a northerly direction and occur within the outcrops of shales west of the road between the Adylam and Ongur road bridges. The sandstone dykes do not have a definite trend but are haphazard in pattern and occur in shales. They cut the bedding of the shales in all possible directions. They are ½ inch to 6 inches in width, their length varying from a few to 10 feet. The wider dykes increase in general, in their strike length before they end abruptly against another sandstone dyke. They are also found to bifurcate. The dip of these dykes varies between 30° to 90° in different directions. The sandstone dyke pattern appears as criss-cross arrangement cutting one another. These dykes are reddish brown in colour and are composed of the same sandstone components that make up the sandstones of this area. These are fine grained, well consolidated and compact and as such they are more resistant to weathering and to the action of flowing water than the shales. The sandstone dykes therefore stand out 2 to 4 inches in relief above the shales. There is no stratification in the sandstone dykes. They occur more or less along the boundaries of the sedimentaries which indicates that these were formed in the shallow region of the basin of deposition. About the mechanism of intrusion, it has been suggested that due to some local earth tremors the wet sandy material was mobilised and pushed up from below into the cracks in the overlying shale where it consolidated as dyke.

53. Tectonic History of the Singhbhum Series North of the Copper Belt Thrust, Singhbhum.

S. N. SARKAR, Dhanbad.

Recent work in the key areas and reinterpretation of earlier data aided by reconnaissance lead to the following tectonic history of North and East Singhbhum between Dalma and Copper Belt thrusts. The Iron Ore Series of Dunn in this belt has earlier been renamed as Singhbhum Series (Sarkar and Saha, 1959, 1961).

In the first phase of the Singhbhum orogeny the rocks of the Singhbhum Series (including Chaibasa and Dhalbhum Stages) and Dalma synclinorium (B-folds), generally overturned towards south, due to a regional north-south vertical couple. Subsequently cross-folds or superimposed (B′) folds are developed at the western and south-eastern parts of the belt. Regional metamorphism during orogeny and development of Chakradharpur granite gneiss on the west and soda granite and granophyre on the SE by syntectonic granitisation at the core of the Singhbhum anticlinorium and Copper Belt thrusting along this core or important episodes.

On the western part of the belt sub-horizontal and westward plunging B′folds, which are generally overturned towards south, appear to be caused by a regional east-west sub-horizontal couple (with anticlockwise movement sense when viewed from above) due to resistance offered by a southern foreland against the progressive Singhbhum orogenic movement from the north.

On the south-eastern part of the belt NE/NNE trending B′folds overturned towards NW, Nichintapur—Gohala wrench fault-cum-thrust and other allied dislocations are developed by an ESE-WNW vertical couple (with anticlockwise movement sense when viewed from SSW) most likely due to the active control by the tectonic trend of the eastern border or basement or caused by an active NNE trending 'geo-fracture' or geosuture.

As Copper Belt thrust is considerably dislocated by the Nischintapur—Gohala fault which itself and the B′-folds are cut across on the north by the Dalma thrust, it is evident that the cross-folding movement continued even after the development of the Copper Belt thrust, and Dalma thrust post dates the cross-folds. From the critical consideration of all the available evidences the development of B and B′ folds and thrusts (with B″ structures) may be generally considered as three successive phases or episodes with some amount of overlapping and alternation between them during one long continued Singhbhum orogenic cycle.

54. Determination of the Height of Pangaea Continent and the Age of Earth by the height and Surface Graph.

SHIVA KISHORE, Jullunder.

The author explains the double hump graph of the earth as due to the birth of the moon and removal of a large amount of upper rocks in the process. This is shown to produce two sharp lines in the surface height graph. With geological changes the sharp lines disperse to become two humps. The amount of dispersion therefore gives a measure of the age of the earth.

The large continents have large average height. The author has assumed that this is due to smaller erosion on large continent. The rate of erosion has been assumed to be inversely proportional to distance from sea. The erosion then comes to be proportional to $1/\sqrt{A}$ here A is the area. Hence $H+\frac{K}{\sqrt{A}}$ should be constant for all continents and is equal to the original height and hence height of Pangaean continent. This height comes to about 1450±50 meters for all continents from the present sea level. And thus taking the average the height of the Pangaea can be said to be 1450 meters.

(vii) Miscellaneous.

55. Mesas of Kasipur, Kalahandi District, Orissa.

S. ACHARYA, Cuttack.

Laterite cappings on the Chandgiri and other hills off Kasipur in Kalahandi District, Orissa have produced absolutely flat-topped hills, areas of which are quite considerable when compared to their heights. These geomorphic features which should be called as 'MESAS' are described in this paper. They have been produced by differential weathering of the streams activated by the rhythmic rejuvenation of a laterite-capped peneplain. The rejuvenation accentuated the down cutting of the rivers and consequently detached and completely isolated the lateritic blocks. Evidences in favour of rejuvenation have also been discussed in the paper.

56. Divergence of the surface water in the north Indian ocean with application to the location of upwelling and sinking.

V. V. R. VARADACHARI and G. S. SHARMA, Waltair.

Vertical movements of water known as upwelling and sinking in the sea, are closely related to the divergence and convergence of the surface waters. It would be interesting to locate the areas of divergence and convergence from a knowledge of the surface currents and to infer upwelling and sinking from the divergence pattern.

The paper presents some of the results of investigation on the location of the areas upwelling and sinking in the North Indian Ocean (between long. 55°E and 100°E) for the month of March, as deduced from the field of divergence of the surface waters. The divergence has been computed by a graphical method from the data on surface currents.

The divergence field indicates strong upwelling off the east coast of India, being especially pronounced in its central part. There are some areas of upwelling off the east and south coast of Ceylon, the south coast of Arabia, and the coastal regions of the head of the Bay of Bengal. Strong upwelling is also indicated in the southeast Arabian Sea and some areas of the equatorial part of the Indian Ocean. The areas of sinking are located off the west coasts of India and Burma. Sinking is indicated also in some parts of the equatorial regions of the Indian Ocean and the central regions of the Bay of Bengal and the Arabian Sea.

57. A note on the ground water conditions of Gulbarga taluk, (Mysore State).

C. GOPALASWAMY RAO, Gulbarga.

The paper deals with the ground water conditions of Gulbarga taluk and its correlation to the associated Deccan traps. The distribution of underground water in this region, unlike in granitic terrain, is found to be quite regular and is confined only to the vesicular and amygdular flows. About 200 wells sunk in different parts of taluk were examined and the data regarding logs of well sections and the average depth of water table in each well were collected. The study of various levels in relation to water bearing strata has shown that the depth of water table reached varies in general from 40—70 feet in southern parts between 1200—1500 contours and 25 to 45 feet in the northern parts between 1600 to 2000 contours. The majority of wells have yielded potable water except in few cases where the water is rendered saline due to contamination of salts of subsoil.

58. Groundwater conditions at Panagarh base, district Burdwan, West Bengal.

SANATKUMAR BASU, Calcutta.

The note embodies the salient features of groundwater conditions of the area around Panagarh (23°27′ : 87°26′; 73M), Burdwan district, West Bengal.

Panagarh is situated on the almost flat to gently undulating alluvial plain built up by the Gangetic river system. The area around it is underlain by a succession of fluviatile sediments consisting of sand and clay. These formations are of recent age. From the study of available bore-hole cuttings it is found that sand is predominant over clay; it is fine to coarse in texture and occasionally mixed with gravel.

Groundwater in the area under study exists both in the unconfined and confined state. Water in the shallow zones occurs under water-table conditions, the water-table resting at a depth of 22—28 feet below ground level. Water occurring in the deeper zones is held under pressure, the piezometric surface varying between the depths of 14 and 28 feet from the land surface. From the analysis of available water level data the water table appears to have a gentle southeasterly slope. Piezometric surface rises considerably during the monsoon, the rise is evidently effected by greater monsoon recharge. Discharge of about 12,000 G.P.H. are common in many of 6-inch diameter tubewells with a drawdown of 6—8 feet down to a depth of 400 feet below ground level.

The chemical quality of groundwater tapped within this depth is very good, being characterised by a chloride content of 20 p.p.m. and 250 p.p.m. of total dissolved solids and is considered suitable for all normal domestic uses.

59. Radioactivity of the rock types of Gazuvaka area, Visakhapatnam district, Andhra Pradesh.

K. VENKATA REDDY and R. V. RAMARAO, Waltair.

The Gamma activity in terms of equivalent Uranium per gram of rock of 6 garnet sillimanite gneisses, 3 acid charnockites, 3 leptynites, 1 intermediate charnockite and 1 porphyritic feldspar granite gneiss collected from Gazuvaka area is determined using a scintillation spectrometer. The radioactivity in terms of ppm of uranium for garnet sillimanite gneiss is in between 9·00 and 14·00, for acid charnockite between 35·00 and 39·0, for the intermediate charnockite 31·00, for leptynites between 19·5 and 28·00 and for porphyritic feldspar granite gneiss 20·0.

Studies are in progress to evaluate any possible discrepancies between alpha, beta and gamma activity of the same rocks.

60. C. M. Patterns of Siwalik Sediments.

A. T. R. RAJU and P. V. DEHADRAI, Dehra Dun.

The texture of a clastic sediment as characteristic of its environment of deposition has been observed by many workers. Siwalik sediments have been studied for their textural features in the Petrological Laboratories of the Oil and Natural Gas Commission and the present paper is based on interpretation of data obtained by the study of over 200 samples belonging to the Lower, Middle and Upper Siwaliks exposed in parts of Punjab (India). Data have been plotted to give CM patterns on the lines suggested by Passega (1957, Bull. Am. Assoc. Pet Geol. Vol. 41 no. 9), to bring out conditions of their deposition.

The study has suggested channel type, and tidal flat to shallow shelf conditions of deposition for Lower Siwaliks, fluviatile to flood-plain conditions for Middle Siwaliks, and Piedmont and fluviatile conditions for upper Siwaliks of Punjab.

61. Dielectric constants of limestones.

S. BALAKRISHNA, Hyderabad.

Dielectric constants and capacitances of a few limestone samples collected from the Huzurnagar area of Nalgonda District, Andhra Pradesh are determined by using a sensitive Q meter that has provision of a capacitance jig. The variation of the dielectric constants in the limestone samples are noted and the dependancy of the value on parameters such as the composition, porosity, grain size and density etc. is indicated. The dielectric constants of limestone samples studied are low and lesser than twelve and hence the possibilities of using them as a ceramic material is also considered, provided the other physical properties satisfy the conditions.

Ultrasonic Velocites in the same samples both longitudinal and tortional are determined and their variation is found to be connected with chemical composition, grain size, porosity etc.

62. Study of mid-rib orientation of fossil leaves, as an aid to determination of palaeo-current direction.

BANKIM MUKHERJEE and SAILENDRA NATH DAS, Jadavpur.

Sandy red shale beds of Barakar stge of the Sahajuri basin (Lat. 24°5′—24°10′N; Long. 86°49′—86°58′E) contain profuse plant fossil leaves of lower

Gondwana flora (mostly Glosspoteris). The leaves are sufficiently elongated (of dimensional inequalities) to be considered as fabric element. The shaly beds were first oriented with reference to geographic north and then removed with shovel. Then the orientation of the leaf mid-ribs on the bedding plans was measured with the reference line and the data were grouped into 30° class interval. Measurements of mid-rib aximuth distribution of fossil leaves were made in three localities viz. Damagora quarry, Khun quarry and Bhowanipur incline.

The vector summation method for the treatment of orientation data has been followed to determine resultant vector azimuth (Θ), magnitude of the resultant vector (R). Rayleigh's significance test has been done to check the distribution against randomness. The probability (p) in each case was found out from the L ($L = \frac{R}{En} 100$) and total number of observation (n). Statistical measures of leaf mid-rib orientation is given below :

Localities		n	Θ	R	L%	p
Damagora quarry	...	128	175°18′	24·70	19·2	$<0{\cdot}01$
Khun quarry ...	...	129	179°32′	45·63	34·8	$<10^{-5}$
Bhowanipur incline	...	112	147°0′	62·81	56·5	$<10^{-10}$

The result shows strong anisotropism in case of Bhowanipur ($p<10^{-10}$) and Khun ($p<10^{-5}$). The distribution at Damagora shows a somewhat less degree of anisotropism ($p<0{\cdot}01$), still above significant level.

The preferred direction thus obtained indicates a palaeo-current approximately from North to South at Damagora ($\Theta = 175°18'$) and Khun ($\Theta = 179°32'$) and at Bhowanipur, approximately NW to SE ($\Theta = 147°$). The directions determined from sand-grain orientation give more or less the same result.

GEOGRAPHY

(i) Geomorphology

63. The Physiographic Regions of the Sagar—Damoh Plateau.

B. G. TAMASKAR, Amravati.

On the basis of geology, geomorphology, relief and drainage patterns, the plateau may be divided into the following physiographic regions and sub-regions :

I. *The North Central Highlands* :
  (a) The Dhamoni Hills.
  (b) The Tinsumal Plateau.
  (c) The Ghatia Upar.
  (d) The Ghatia Niche.
II. The North-eastern Plateau.
III. The Bearma Basin.
IV. The 'Haveli' or the Sonar-Kopra Doab.

V. *The South-eastern Highlands* :
  - (a) The Jabera Basin.
  - (b) The Mohli and adjacent group of hills.
  - (c) The Bhander Hills.
  - (d) The Kaimur Hills.

VI. *The Abchand-Naharmau Highlands* :
  - (a) The Rangir Hills.
  - (b) The Naharmau Plateau.
  - (c) The Jamunia-Chikhali Hills.

VII. *The Sagar-Jaisinagar Highlands* :
  - (a) The Sagar Hills.
  - (b) The Dhana Plateau.
  - (c) The Jaisinagar Upland.

VIII. The Dhasan Basin.

IX. *The Rahatgarh-Malthone Range* :
  - (a) The Piprasari-Malthone Hills.
  - (b) The Pithoria Hills.
  - (c) The Rahatgarh Hills.

X. *The Badar-Bina Doab* :
  - (a) The Basahari Plateau.
  - (b) The Parsari Basin.
  - (c) The Betwa Basin.
  - (d) The Narain Basin.
  - (e) The 'Jhilla'.

The notable geographical peculiarities of each of the regions and sub-regions have been discussed in this paper in some details.

64. The geomorphology of the peninsular India.

R. P. SINGH, Patna.

The face of the Peninsular India has been carved out of its architectural plans of the past in relation to the grinding action of the dynamic wheels of denudational cycles. Its morphology even in its bare outline suggests polygenetic and complex phenomenon. The vertebrae of its ancient mountains like Aravalli, Western Ghats, Eastern Ghats, Satpura, spread almost engirdling the jutting landmass of the subcontinent. The cuddapah and the Vindhyan form unconformity. The sinking Permian trough recorded a chapter of sedimentation. Erosion and uplift explain its morphology. Minor inroads of seas explain the scenery in the coastal areas, and Bagh and Lameta beds.

The Rajmahal and Deccan lavas constitute significant chapter of volcanic emission and explain the scenery of their respective areas in relation to the development of denudational cycle which was augmented by Tertiary epeirogenetic reactions. The present landscape is clearly understood when the chapters of Tertiary events are constructed. The history of the Peninsular landscape consists of several chapters involving denudation, and deposition; folding, uplift, warping tilting, tearing and rifting; widespread resurrection and volcanic emission.

The author has suggested a scheme of landscape studies basing upon the three primary elements of landscape- structure process and stage.

The denudational cycles peneplaining its landscape have been treated in relation to the Peninsular parentage with Super-continent of Gondwanaland and Asia.

65. Changes in the drainage pattern in the middle mountainous country of Orissa.

B. N. SINHA, Kharagpur.

The mountainous region of Orissa covers about three-fourths of the area of the entire State. It is a part of the Indian Peninsula with a general slope from west to east prior to the upliftment of the Eastern Ghats and the drainage channels were "consequent" in type. Subsequent to the Lower Gondwana deposits to the south-east of Cuttack during the Permo-Carboniferous period, the region along the eastern coast of India from Chota Nagpur Plateau upto Madras underwent a tectonic uplift. The old maturely disected surface was elevated upto a height of 300 metres and almost all the major rivers of Orissa could maintain their west-east courses as they have cut through the 300 metre contour line.

This deeply eroded plateau along the rejuvenated long profile also underwent two other upliftments which elevated the older surface to 600 and 900 metres in two stages. This resulted in a sharp watershed in the heart of Orissa which beheaded many of the rivers from their head waters except the Mahanadi and Brahmani which could maintain their original west-east flow.

The beheaded rivers were the Budhabalanga, Subarnarekha, Rushikulya, the Vamsadhara, and the Nagavali. The tributaries like the Koel, the Ib and the Tel came into existence on the western slopes of the Eastern Ghats with S.W.-N.E. or from N.E.-S.W. courses which captured the head waters.

It appears that the upliftment of the Eastern Ghats was completed in three successive stages or there was sufficiently longer interval between the last two upliftments.

This has been suggested by taking cross sections along the interfluves of the major rivers and at right angles to the present drainage channels. All the cross sections reveal the well developed accordant summit levels at 900, 600 and 300 metres. The beheading of the rivers can also be linked up with not only the elevations of their beheading but also with the stages of upliftment.

A study of the mouths suggests their abnormally big sizes, compared to their present catchment areas. If the main streams of the beheaded rivers are hypothetically projected in their upper reaches they roughly coincide with the general trend of the drainage pattern beyond the western slopes of the Eastern Ghats.

Further work is essential for the final conclusion of the supposition.

66. Rajmahal hills—a type study in relief and dissection index.

ANNAPURNA PRASAD MISRA, Varanasi.

The paper seeks to discuss the application of Dovnir's method of determining the Dissection Index to a part of Rajmahal Hills. The author's conclusions do not correspond with those arrived at by Dovnir.

According to Dovnir the Dissection Index is highest where the absolute and relative reliefs are medium, the Dissection Index is high in the areas of minimum absolute and relative reliefs; the Dissection Index is at its minimum when absolute relief is highest and the relative relief is medium.

The author's findings reveal that the higher hilly tracts possess greater relative relief and high Dissection Index. The uplands with moderate elevations possess moderate amount of relative relief and medium Dissection Index. In the plain area the relative relief is less and the Dissection Index is low.

The present author, therefore, is of the opinion that Dovnir's conclusion, based on observations made in a smaller area on the basis of a new method adopted for the purpose, cannot be generalized. They do not hold true for terrains of all descriptions.

67. Movement of ground water in Meerut district, Uttar Pradesh.

R. N. MATHUR, Varanasi.

The district of Meerut covers 2,300 square miles of the Upper Ganga Doab of Uttar Pradesh. The rate of movement of ground water in the district has been found to be about 50 feet per year. The present paper records mainly the results of an investigation undertaken to study the direction of movement of ground water.

The actual direction of ground-water movement is from north to south, that is, in the direction of surface drainage, while the maximum water table gradients generally show an east-west trend—from the ground-water ridges, underlying the main canals, towards the ground-water valleys, underlying the main streams of the district. The canals courses generally run along the higher ground, that is, along the surface drainage divides between the adjacent streams. The occurrence of the ground-water ridges and the ground-water valleys actually reflects the influence of the surface relief features. The possibility of any ground-water movement from the ground-water ridges towards the corresponding adjoining ground-water valleys is definitely ruled out on an examination of the question of influent seepage from the canals.

68. Hydrography of Kolleru lake.

V. VIDYANATH, Hyderabad.

Hydrographical studies of coastal and inland lakes in India have been sadly neglected. The present paper attempts such a study of Kolleru Lake in the coastal area of Andhra Pradesh. The lake is connected with the Bay of Bengal by a smaller stream Upputeru. The lake originated as the natural remnants of a lagoon between the deltas of Godavary and Kistna rivers. It is also probable that the lake originated as a delta-flank depression as a response to the isostatic disturbance created by the sedimentation in the active deltas.

The catchment area of the lake is about 2,200 square miles while the annual yield of water is about 62,548 million cubic feet computed from Strange's Table of Runoff. Seasonal variation in the river regimes has a corresponding variation in the inward discharge and the waterlevel of the lake. The peak flow into the lake is about one lakh cusecs. The maximum depth about −3 ft. and the miximum height is about +10 ft, where the area of the lake reaches 345 square miles. A part of the Yerrakalva's discharge falls into the lower reaches of the Upputeru raising its level higher than that of the lake, and thus, retarding the discharging activity of Upputeru. Some suggestions to control the water level of the lake have been put forward based on the hydrographic features. The diversion of stream flows into Krishna and Godavary rivers should be explored.

69. Geomorphic analysis of upper Ganga-Yamuna Doab.

A. B. MUKHERJI, Hyderabad.

Geomorphological analysis of the Upper Doab reveals two broad geomorphic units; the Recent Floodplains of Ganga and Yamuna Rivers, and the Pleistocene Terrace wedged between them. The sharp contrasts between the geomorphic characteristics of the two units are expressed by the sub-parallel and dendritic drainage, and incised channel patterns on the latter surface; and the Yazoo drainage and braiding channel patterns on the former; the braiding being due to the excessive bedload of easily erodible loose sand.

Identification of the interfluvial upland as a Pleistocene, adluvial depositional terrace is based on the following facts : topographic conjunction of the Indo-Gangetic Divide as the valley wall and the Terrace; horizontally stratified, thick, alluvial deposits; presence of lenticular, gravelly sand pockets in the subsurface layers, and that of clay on the surface indicating a grading of coarser to finer materials as a result of alluvial deposition; reddish colour of its sediments as an evidence of exposure to air, leaching, and oxidation in the pre-Recent period. Epeirogenic movement due to continuous isostatic activity transformed the Pleistocene Flood-plain into a Pleistocene Terrace, and tilted it toward the east; as evidenced by the eastward slope and incised channel patterns.

The medium drainage texture of the Terrace is due to its slight, initial relief, and permeable surface materials; while the fixation of the channels by resistant materials of Pleistocene outcrops and clay plug fillings of abandoned meanders, has resulted in their conspicuous deformities. Shallow fault controlled deformities are suggested by the recurrent patterns of right-angular confluences of streams.

The principal contribution of the paper is the identification of the interfluvial upland as a Pleistocene, alluvial, depositional terrace.

(ii) Climatology

70. An analysis of weather types of rainy season in U.P. A study in Bio-climatology.

R. N. TIKKHA and INDRA PAL, Agra.

A detailed study of the weather types of U.P. has been made from the point of human comfort on a quantitative basis. For this purpose Nicholas' method of classification has been modified in the light of scientific experiments carried out in the John B. Pierce Laboratory of Hygiene, Neewhaven, U.S.A.

Temperature, Relative Humidity, Wind and Sunshine have been studied at 8-30 A.M. and at 5-00 P.M. in the rainy season for a period of ten years. The average of data has not been taken because extreme but important weather types are lost in this process of average taking. This, therefore, needed about 37,500 readings of these elements.

As expected, oppressive weather types do not occur at Mussoorie which represents northern hilly part of U.P. Mornings and evenings at Mussoorie are comfortable.

In the plains comparatively very few weather types occur in the mornings than in the evenings. Though weather types are usually very uncomfortable, evenings of course more.

East U.P. has a higher frequency of oppressive weather types than the West. In the evenings oppressive weather types, however, spread through U.P. plains but highly oppressive weather types are more frequent in East than in the West.

71. Analysis of the Rainfall Regimes in India during the period of 180 days beginning from the 1st May.

K. RAMAMURTHY, Poona.

In this paper an analysis of the rainfall data for 50 selected stations in India for 50 years during a period of 180 days, consisting of 58 five-day periods or pentals beginning from the 1st May, has been made using the medium as the statistic after Crowe and Savur.

It has been observed that along the west coast of India, the duration of the monsoon season steadily diminishes northwards, but the rain amounts increases from Thiruvanathapuram (Trivandrum) to Marmagoa and thereafter decrease rapidly. The bursting of the monsoon is most significant at Bombay.

The poor rains of Rajasthan are at a maximum in the pental July 20 to 24. Srinagar has an even spread of rain in all the pentals though the amounts are very small. In the Punjab the main maximum occurs in July 20 to August 3, whereas in the middle Ganga basin it occurs in August 4 to 8 in the south and 9 to 13 in the north. There is a tendency of the upper quartiles increasing towards the end of the season, pointing to the likelihood of heavy shows in some years. At Jalpaiguri very heavy rains occur from June 20 to July 9, when the median is greater than 9 cms. in each pental.

On the northern part of the east coast the monsoon rains show a very great variability towards the end of the season and in the southern part of the coast the real rains begin after October 12th. At Pamban there is practically no rain at all up to October 17th.

In Central India the rainy season extends from June 20 to September 27. In the northern part of the peninsular interior the monsoon rains are divisible into two parts marked by a pronounced minimum in between. The hot weather showers increase in the Peninsula southwards, where in the interior the later part of the monsoon has heavier rains.

72. Climates of the Mysore State

A. R. SUBRAMANIAM and V. P. SUBRAHMANYAM, Waltair.

The climatological features of the new Mysore State in Peninsular India are discussed. An attempt has been made to study the climatic types of the Mysore State according to the well-recognised and widely-accepted Scheme of Classification of Thornthwaite.

The map of climatic types of the State according to the moisture regime shows a progressive gradation of climates from arid in the central portion to perhumid on the West Coast. These several climates are seen to owe their existence to the Western Ghats. The wide areal extent of the arid climate seems to be a very striking feature of the map.

The climatic map based on thermal regime shows that almost the entire State has a megathermal type of climate, except in the Ghat regions around Bale Honnur and Marcara where meso-thermal zones are found. This signifies that the temperature efficiency of the entire region is more than adequate to support forest type of vegetation.

Five stations belonging to different climatic provinces in the State, namely—Mangalore (Perhumid), Belgaum (Humid), Bangalore (Dry Sub-humid), Mysore (Semi-arid) and Bellary (Arid), have been selected and their water-balances are graphically illustrated. Such elements of the water budget like Water Surplus, Water deficiency, Actual Evapo-transpiration as well as accumulation and utilization of soil moisture are all clearly observed from these illustrations. The graphs show not only the magnitudes of these parameters but even their durations including the times of commencement and cessation.

Work of the above nature is highly important not only in climatic studies but also in such fields as agriculture, forestry and hydrology for purposes of land reclamation and development.

(iii) Economic Geography.

73. Well irrigation in ancient India.

K. SURENDER REDDY, Hyderabad.

The course of Civilization is intertwined and bound up with the availability of water. Take water avail, Civilization disappears, Mohanjodaro and Harappa proved that our ancients knew digging wells and irrigating lands. Perhaps the well is the first symbol of conquest of man over nature. Historically we have nothing on record to show that wells are exogenous to our Civilization.

Whether the needs of irrigation prompted the digging of wells or the marching of the armies necessitated their construction, is a debatable point. However one thing is certain. The Indus Valley Civilization stands out unique among contemporary Civilizations to the extent that it had more permeating distributive effect on all sections of the community. In Greek and Egyptian Civilization dirt and squalor co-existed with pieces of rare architecture. Hence one is forced to conclude that wells formed an evolutionary process in one of the strands of Indus Valley Civilizations.

The Persian Wheel, was also known during the vedic period from the technique adopted for drawing water in the rural sector of our country even today it appears to us that so little has changed that the vedic period continues still in our country.

In the south we have no reason to belief that prior to Indus Valley civilization wells existed. That irrigation was known in the south during early times, is beyond doubt. But it is not possible to link up early irrigation with well sinking perhaps the cultural and political contacts between the north and south might have given birth to wells in the south. Philology lends little support to this theory, unless it be that the Indus Valley civilization itself was Dravidian in its Origin.

74. Broach, the declining river port of western India.

A. T. DESAI, Ahmedabad.

The paper attempts to bring out the development and importance of Broach as an inland river port located on the river Narmada. In the pre-steam navigation age the port was more accessible from the inland producing areas and the market of consumption. In the absence of railways, sailing vessels were the most economic means of transport and Broach was one of the few important centres of trade that served a vast area of Gujarat. A favourable inland location having greater accessibility, a rich hinterland and a very extensive foreland of Arab Countries, Indian Sea Coast and even the Far East and European nations were the factors responsible for early development of the port. Added to these advantages was the deep and capacious estuary of the river Narmada which has been protected by the occurrence of few islands in the estuary.

The port, however, has been declining for the last few decades not only because of better land transport by rails and roads but also due to competition from steamships which are more efficient, economic and secure and for which Broach is not suitable. The port nevertheless can be of great help for the coastal trade of Gujarat within a limited area.

75. Gola—a decadent small river mart.

KASHI NATH SINGH, Varanasi.

The present study deals with Gola (26°26′N. lat. and 83°22′E. long.) a small market town (4157), 33 miles south-south-west of Gorakhpur, in the Saryupar Plain, U.P., India, now on the bank of the Ghaghara and formerly on the Kuana. The prosperity of the town has intermittently waxed and waned, almost with a mark of regularity, with the caprices of the Ghaghara.

Village Madri, situated on an eminent bluff along the navigable Kuana, was selected by the Raja of Gopalpur as the site of a market town in the early part of the last century and was named Gola. The Kuana made a confluence with the Ghaghara just a few furlongs down the site. With such locational advantages and the benevolent patronage of the Raja, the town soon developed into an important entrepôt of the region. The growth of the town, however, was marred in the 1840's when the Ghaghara usurped the lower channel of the Kuana and thus the traffic bound for Gola diverted to Shahpur, the new confluence site upstream. About 1855 the Ghaghara 'reinforced the Kuana with its channels and the town could as a grain emporium compete with Barhaj.' This channel ceased to flow, however, by 1872, and the town looked again, 'poor and squalid enough'. But subsequently the Kuana again increased in volume about 1879 and the 'prosperity of Gola revived.' Eventually, however, the Ghaghara itself adopted a more northerly course, usurping the Kuana at Shahpur, and began to flow by the town. As such, the town became a port of call for the streamers along the Ghaghara, but this through traffic could not supplement the loss rendered by the truncation of the Kuana. This was the first stage of the decadence of the town, while the most fatal blow was struck with the divergence of the river traffic to the railway and the consequent rise of alternate centres like Shahjanwa, Dohrighat, and Barhaj, placing Gola in a marginal position in regard to its umland.

76. Industrial regions of Kumaon.

Y. D. PANDE, Naini Tal.

Industrially Kumaon is under-developed; even her cottage industries are at their lowest ebb in most of the cases. Excepting five units of Naini Tal Tarai and Bhabar, there are no large scale concerns in the hilly tract of Kumaon.

After discussing briefly the natural setting, system of industries of Kumaon has been discussed. Kumaon has been divided into three industrial regions. (1) The most important cottage industry of the northern Bhotia region is that of woollens, which has become part and parcel of Bhotia's life. (2) Important industries of central region are that of wool, leather, forests, bee-keeping, ringals, wood-works, tea, hemp cloth weaving, etc. (3) Industries of Tarai and Bhabar are more akin to that of Ganga plains of U. P. Five large scale concerns are located in this region, of which three are sugar mills. Important small scale and cottage industries are that of catchu making, dairying, wood-sawing, furniture, mat-making, basket making, ban, cloth printing, gur making, etc.

Generally speaking, poor returns from agriculture as well as from industries has resulted in grinding poverty and an encircling gloom of distress and desperation. Since there are potentialities of developing certain profitable industries, the battle of poverty in Kumaon is to be fought on industrial front and that too immediately before it acquires gargantuan proportions.

77. Regional Crop Patterns of India.

SHYAM S. BHATIA, Delhi.

This paper is concerned with the regionalization and discussion of the crop patterns of India. For each district of India, the crop area under selected crops is individually related to the corresponding crop areas in the entire country, taking the crop area as a fraction of the sown area. A comparison of the area under a given crop as fraction of the sown area in a component areal unit to the corresponding value in the whole country forms the basis of determining the degree of concentration of the given crop. The regional variations in the degree of concentration of different crops are mapped and the resulting patterns of distribution are analysed.

78. India's river valley projects.

R. C. SHARMA, Allahabad.

At this juncture when our economy is at 'take off stage' of National Planning and when the nation's population is increasing rapidly at unprecedented scale, the survey of these River Valley Projects is of vital importance. Since the inception of National Planning Committee and the institution of Planning Commission, the past experiences of these valley projects are rather discouraging, as almost each and every project is beset with one or more difficulties and mishaps, some have been planned so ambitiously that the proverb 'cart before the horse' has become true, some have become too costly adventures, some have become the bone of contention and border disputes, and most of them become the prey to the evil of 'delay'. The present study aiming to investigate the geographical problems concerning the projects and of their commanding area is most timely and of some value to the planners of the nation and the geographers of the country.

In the present context it will not be possible and proper to survey all the schemes planned and executed by the central and state Governments by spending a huge sum. So this will mainly focus light on more important projects i.e. D.V.C., Hira kud, Kosi, Rihand, Bhakra, Nangal, Rajasthan canal, Chambal, Koyna, Nagarjunasagar, Tungabhadra and Mettur etc. With respect to the locational pattern of the River Valley Projects, the whole country has been divided into four regions -- the Chhota Nagpur Plateau region, the Plateau division of U.P. and Madhya Pradesh, the Umland of Delhi and Punjab region and the Peninsular India. And in these regional domains the study has been made of the individual project and of their salient features and the progress through the 1st and the 2nd Five Plans. In the end, it has been realized that though these multi-millions ventures were launched to shape future of Indian economy and to raise the standard of living of the masses but in their execution many evils crept in, which have stained and polluted the wholesome atmosphere.

79. Small scale cottage industry in Kathmandu valley.

KRISHNA DEO PRASAD SINGH, Varanasi.

This submontane valley of Nepal, nestling on the lap of Himalayas, has its economy practically static since generations. Shut out to and from outside world till 1951, it was deprived of all the amenities of a civilised existence. Practically speaking there is no large-scale industry.

At present, Blacksmithy, Wood-working, Brick and Tile making, Wool carding and weaving, Textile, Pottery, Metal and leather works are the only industries flourishing on small scale. The valley is still at its primitive stage of iron utilisation. There is no mineral wealth. Some constructional materials like iron scraps are imported. The valley is well known for its traditional wood-carvings. This art has flourished, since generations, and has produced its own style of figure and relief. However, today, the scarcity of workable quality wood is being felt badly, as the indigenous forest wealth has been over consumed. Brick and tile is also one of the flourishing industries. But due to shortages of fuel the number of kilns are meagre to meet the increasing demand of bricks. Woollen products like 'Pashmina', Shawls, mufflers and rugs of the valley are renowned for their quality, even in foreign markets. But it is still an indoor activity. Till the last century, hand made cloth was a family affair. Cotton was imported from India. Now it has almost declined and the textile goods are the largest single item of import. The finest pottery of Nepal is made here. This is another traditional art. Though, these are other activities carried in the valley, these are insignificant.

The economic prosperity of the valley is clogged due to the inadequacy of capital, absence of economic environment, lack of transport and communication facilities, illiteracy and social problems. If measures are taken to eleminate these drawbacks, the prosperity is near at hand.

80. The nature and flow of bus traffic in Uttar Pradesh.

RAM BRIKSH SINGH, Varanasi.

The major portion of intercity passenger traffic is handled by roads. The road pattern of U.P. is fork-shaped in the Doab, interwoven by transverse and oblique roads, rectangular in the Lower Ganga Par Plain, tentancle-shaped in the inaccessible region, the Himalayan west, Tarai belt southern upland and Upper Ganga Par Plain and rib-pattern in Saryu Par Plain.

Bus traffic flow has the following features of density and direction.

1. There are several regional centres serving as focal points, which naturally gravitate, most of the traffic towards them. Significant among them are Delhi (outside), Meerut, Agra, Mathura, Aligarh, Kanpur, Lucknow, Bareilly, Moradabad, Azamgarh, Allahabad, Varanasi, Gorakhpur and Basti.

2. Because of the broad expanse of the State and short haul nature of the bus transport distinct traffic regions have emerged. These are (i) The Ganga-Yamuna Doab West, (ii) The Upper Ganga Par Plain West, (iii) The Upper Ganga Par Plain East, (iv) The Central, (v) The Eastern, (vi) The Saryu Par Plain or North Eastern, (vii) The Himalayan West, (viii) The southern Upland. The vast extent of U.P. with its diversified relief features, the degree of rail facilities available, the different types of economic activities in relation to regional focies their interrelation together with the density and distribution of population explain their traffic flow characteristics.

The general direction of bus traffic flow is parallel to the river Jamuna, Ganga and Ghaghra. Due to lack of bridges over the rivers North-South movement is broken.

81. Suratgarh farm—a Geographical Appraisal.

S. L. KAYASTHA, Varanasi.

Suratgarh (29°20′N. and 73°54′E.) lies on the Jodhpur-Bikaner-Bhatinda railway line, at an elevation of 600′ on the left bank of R. Ghaggar. Headquarter of a tahsil in Ganganagar district, it is a small dusty town on the fringe of desert.

Suratgarh first attracted wide notice on account of the siting of Central Mechanized Farm.

Work on the Farm started in 1956 with the help of farm machinery received from the Soviet Union. The Thirty Thousand Acre Farm comprised of unpromising land covered with sand-dunes and xerophytic vegetation. Here, rainfall is deficient, winter frosts are not uncommon, and excessive heat and sand storms menace summer. Soils suffer from lack of moisture and alklanity. Water-table is deep and sub-soil water is often brackish. By 1959-60, more than 2/3 of the area had been reclaimed and most of it brought under cultivation. This was made possible by the use of farm machines. Yields are average but are maintaining an upward trend. Farm economy is well organised.

The Farm performs the function of multiplication of improved seeds and proposes to breed pedigree cattle and supply quality nurslings. The propagation of pedigree seeds, pedigree cattle and pedigree plants will transform the face of land and increase agricultural production. The Farm is a positive step towards augmenting food-supply in the deficit zone and is a model of mechanized and scientific farming.

82. Rice cultivation in Kolleru Lake.

V. VIDYANATH, Hyderabad.

Rice cultivation in the bed of Kolleru Lake, Andhra Pradesh is an interesting study of cultural adaptation to hydrographical features of the lake. The present paper analyzes the techniques of cultivation of rice in the lake. It was found that there is a significant correlation between the seasonal variation of the waterlevel of the lake and the availability of the exposed land for cultivation. Irrigation is done by lifting water from the lake by engines. During the first crop season fishing is substitutes cultivation activities. *Nallarlu, Akkuleru,* and *Konamani* are the important varieties grown in the lake. Different varities are grown in the two' crop seasons. The significant difference between the first and the second crop season techniques is bunding in the latter. Transport of paddy is done on boats in the first crop season while in the second season by bullock carts. This change in transport is due to the alternating wet and dry conditions of the lake. Most of the other techniques involved in the cultivation of rice in the lake are similar to those of the surrounding areas. A systematic and detailed analysis of these are given in the paper.

83. Coal industry in Chota Nagpur highlands.

RAMESHWAR PRASAD SINHA, Bhagalpur.

The occurrence of coal in Chota Nagpur Highlands is determined by the distribution, nature and structure of its geological formations of Gondwana-makings. It lies in the Damodar and the Auranga basins in an east-west direction and in a few isolated areas of Hazaribagh, Rajmahal and Daltanganj. The Indian Coalfields Committee 1946 estimated the reserves of workable coal in Chota Nagpur at 13146 million tons i.e. 81 per cent of India's total reserves of 16484 million tons.

Coal-mining in India was started in 1774 in Raniganj area, but its earliest scientific exploration was launched in 1845. During the First Great World War, out of India's total output of 21 million tons, Chota Nagpur shared 16·5 million tons, which had gone down in the inter wars periods. The Second Great World War gave a stimulus to its produces and the production of the region rose progressively to 15·9 million tons in 1942 and 16·50 million tons in 1945.

The planned development in Coal Industry was undertaken only after Independence during the pre-plan and best plan periods. The successful completion of the production reached 20 and 28 million tons respectively. This output will have to be further increased to meet the growing demands of the developing economy of the third and the subsequent plans.

India's industrial economy is based on coal of Chota Nagpur region. The development of coking coal of all grades and qualities encouraged the establishment of TISCO, ISCON, MISCO, Rourkela, Bhillai, Durgapur, proposed Bokaro, and a few future steel plants of the country. It provides fuel to Sindri, Bokaro, Chandrapura, proposed Patratu Karanpura and other growing thermal projects, railway engines, local and nearby factories, domestic works, and infinite variety of plants manufacturing by-products.

Out of 845 coal mines in India Chota Nagpur has 535 of which 250 are mechanically worked and 285 manually. The average daily number of persons employed in all the coal mines in India was 3,52,800 out of whome 1,82,500 persons were employed in the coal mines of the region in 1960-61.

84. Crop pattern in the Sub-Himalayan Region of Eastern Uttar Pradesh.

MOHD. NASEER KHAN, Allahabad.

In this belt of Terai-alluvial complex which presents a fertile field of geographical study; topography and climate, soil and vegetation with their varieties and vicissitudes have induced typical human response. The region shows a wide range of rainfall between north and south and the production in terms of cereals is not impressive. Dominating features of agricultural situation in the region are three fold : the or low productivity of most of the region's land surface, the failure of the region's agriculture to meet in full nutritional requirements of the population, and thirdly the adverse physical forces in the form of pests and variability of rainfall leading to soil erosion and floods.

The points emerging from the study are as under :

(1) The region is not over-generously endowed by nature with good agricultural land and is faced with the prospects of rapidly expanding population; maximum output in terms of food value is essential.

(2) Except in the case of rice, it is difficult to establish any close co-relation between physical environment and land-use and sometimes crop pattern.

It would seem that a closer adjustment between the physical environment and improved farming practices are essential if the region is to attain its maximum food output.

85. Transportation of coal from West Bengal-Bihar coalfields.

JAGDISH SINGH, Varanasi.

West Bengal-Bihar coalfields account for 90 per cent of the country's annual output. The transportation of this coal for distribution all over the country is of utmost importance because any falling back results in severe power crisis.

On the basis of the distributional pattern of this coal the country can be divided in six regions. (1) the western and Northwestern region. (2) The Down country region. (3) Bombay-Madhya Bharat-Saurashtra region. (4) Andhra-Orissa region. (5) The Central region and (6) The southern region. Of these the first two regions receiving 8·2 and 7·1 million tons respectively are the most important and the last three are comparatively insignificant.

Distance from these coalfields, the amount of other powers mainly hydro-electricity available, presence or absence of local coal, nature of industries and level of industrialisation, facilities of getting coal from these fields by other means, and the level of demand of coal for domestic purposes explain these differences.

The railways handle almost all the coal traffic of these fields. The Grand Chord line bears the heaviest traffic going towards the first region. The limited capacity of Mughal Sarai yard is the main bottle-neck. This along with the shortage of wagons has created a coal crisis in the first region.

The following measures are suggested to ensure efficient transport of growing coal traffic from these fields in future.

1. Construction of a Trans Ganga Chord by converting the metre gauge trunk route via Gonda, Gorakhpur and Chapra upto Barauni into broad gauge and linking it to Sitapur.
2. Doubling and improving the Burwadih loop and the Garhwa Road Churk link under construction.
3. Encouraging road transport from these fields upto Varanasi by liberalising the permit rules and speeding up the construction of proposed road bridge over the Son at Delhi.
4. Diverting the coal for coastal shipping from Raniganj to water transport in Damodar upto Calcutta by creating suitable facilities.

(iv) Human Geography.

86. Pattern of Growth of India's Cities of over 100,000 in 1951, during 1901—51.

AMRIT LAL, Chandigarh.

This paper analyses regional variations in the population growth in India's 71 urban places, classified as cities in 1951, since 1901 and compares the growth rates of manufacturing and non-manufacturing cities during 1931-51.

The population of these urban places has grown faster than India's urban population, and most of this increase occurred during 1931-51, when the growth rate was 107 per cent against 37 per cent during 1901-31. The number of 'Cities' also multiplied remarkably during 1931-51.

During 1901-11, the north, central and western zones had most of the places with a declining or stationary population, whereas in the south and east zones most places kept growing. During 1911-21, the places in the west and central zones grew faster than those in other zones. During 1921-31, the growth was considerable for all urban places, although fewer places in the north had high growth rates. During 1931-51, a period of accelerated and vigourous growth, more places had higher growth rates than ever before; 26 places grew at rates of 106-215 per cent. The central, western and eastern zones had the largest share of such cities.

An analysis of growth rates (1931-51) of manufacturing and non-manufacturing cities indicates that (a) the most potent factor for growth is a high relative employment in manufacturing, following by public administration, transport, professional services, and retail trade, and (b) among manufacturing cities, specialization in transport and public administration are contributing factors.

87. Growth and Trends in Population of the Tarai region of U.P.

L. R. SINGH, Allahabad.

The scattered ruins and historical records provide ample testimony that the Tarai Region of U.P. is a region of ancient settlement. During the Buddhist period it was a flourishing land having comparatively large population. However, with the fall of the Gupta Dynasty, and, especially after Harshavardhan of Kanauj, a sordid political confusion took fast grip of the country, and, perhaps, an adverse climatic change added fuel to flame and Tarai shrunk in prosperity. Progressive decay set in : cities desolated, farms and fields deserted, the region relapsed in the "dark jungle" by 1100 A.D. According to Muslim historians it was hither and thither interspersed with patches of grazing and cultivation and a few aboriginal tribes, like the Tharus, the Bhoksas and the Bhars occupied the land.

However, its destiny changed with the rise of local feudalism under the Muslims and during Akbar's times it was under the Mughal sway as a frontier or "marginal" tract. During later Mughals and under the Nawabs of Oudh, it became a much settled country with an approximate population of 2 millions.

During early British period it once more declined. But later on, some enthusiasts like Sir Ramsay took lively interest in the Tarai development by encouraging the people to settle down there. Nevertheless, Tarai remained for long a resort of famine striken and the like and gained in population as a marginal land at a cost of Ganga plains. But the ultimate conquest of Tarai began in the post-independence are for settling the uprooted, cultivators from Pakistan, providing employment to the demolished soldiers and the unemployed and for increasing food production to feed the hungry millions. As a result the 1951 census recorded a population of nearly 2·5 millions in this region.

The recent trend of population has been upward, but the settlement of Tarai in the manner of the Ganga Plains seems to be problematic, for the geographical conditions of land will sanction no such wide latitudes.

88. Educational institutions of Lucknow—A study in Social Geography.

M. N. Nigam, Kanpur.

The educational institutions of Lucknow started as 'Madrasahs' during the Nawabi-days. The present system of education began during the British-period. At present Lucknow has almost all types of educational facilities beginning from the primary upto research. Higher education is imparted in Arts, Science, Law, Commerce, Education and Medicine faculties. In addition there are several technical and professional institutions also in the city. For the intellectual class, there are 28 different types of associations and societies and several big libaries.

There are 152 primary schools, 8 junior high schools, 4 high schools, 29 Inter colleges, 7 degree colleges, and more than 20 technical and professional institutions in this city. The enrolment in primary schools varies from 52 to 393; in secondary schools from 150 to 1760; while in colleges it is from 360 to 830. The city has good facilities for female education. Most of these institutions are privately managed.

The establishment and development of these institutions have caused a large number of people to come to the city for settling permanently and have thus helped in the expansion of the city in area and the growth of multifarious activities.

It is suggested that Higher Secondary schools and technical institutions should be shifted on the periphery, i.e. away from the city heart. The University is rightly located. The areas of high density of population need several new primary schools. The primary and girl's institutions may remain where they are, but some improvement has been suggested for them. Thus replanning of these institutions is necessary, both for reducing the pressure of population in the city proper, and for providing better environment to both, teacher and the taught.

89. Origin, evolution and dispersal of Bhawanti House type in Andhra Pradesh.

A. B. MUKHERJI, Hyderabad.

Bhawanti house type is dominant and has a continuous distribution in Telengana and Andhra regions; while in other regions of Deccan it has a disjunct distribution and a recessive existence. Neither the word *bhawanti* nor the associated house type is known outside the Deccan. Its morphology is essentially square; and its structure comprised of four dwelling units (*chatursh‌ala*), surrounding the central hall, completely closed by the projecting roofs of the rooms, except for a small, square opening in the center. Just below the opening is a small, square pit in the central hall. The roof consists of four gables forming a pyramidal shape.

Linguistic evidences based on the derivation of *bhawanti* and *chatursh‌ala bhawanti* from the Sanskrit words *sah bhawanti;* and the current usage of Dravidian words *nalgupura* and *nalgusutra* without any reference to the architectural form or structure points definitely to an Aryan origin of the form of the house. Bhawanti form is therefore, not indigenous to Telengana or Andhra regions. The use of the central hall as a place of family reunion and of the pit as a marriage mandap where the rites can be witnessed by the heavenly bodies is clearly a derivation from the central, square courtyard of the Aryan house with the same functions.

The pyramidal roof is an adaptation to heavy, short-duration rainfall, and hence must have originated in the coastal Andhra region, and cannot be an indigenous evolution or an independent origin in Telengana. Its dominance and continuous distribution in Telengana is due to, both, a transference of culture trait along with the migration of Telugu people including Reddis from the Andhra regions and their settling in Telengana; as well as, to the migration of a culture idea without involving any migration of a people.

The morphology of the bhawanti and its central hall is Aryan in origin while the roof is Dravidian.

90. The origin and racial affinities of the Bhils.

RAJ KUMAR NIGAM, Kanpur.

Regarding the origin of the Bhils there are many theories and innumerable historical and anthropological views are expressed by the various authors namely Manu, Webers, Commentator Mahendra, Enthoven, Gunadhya, in the Puranic and Mahabharat accounts, in Bhairawi's poem Kiratarjuniyam, Valmiki's Ramayan, Kadambari of Ban Bhatt, Abul Fazal in the famous Ain-i-Akbari, Lt. Col. Tod, and many others from time to time. But finally as Dr. Majumdar puts it, it seems, he says; 'Bhil is a generic name given to the various older and simpler peoples of the land by other invading people. The same is the case with the Rajputs who do not represent a specially homogenous type, while the racial status of the Bhil on anthropometric grounds is uncertain as diversified opinions are expressed by Prof. B. S. Guha, Herbert Risley, Crooks, Mahalanobis, Stephen Fuchus, E. W. R. Macfarlane, P. G. Shah, T. N. Dave, Dr. T. B. Naik, Dr. D. N. Majumdar and Smt. Uma Bose, and the general conclusion that one is tempted to reach is that the Bhil is a term used to include all those people who live by chase; i.e. those who use bow and arrow—the term 'bhil' is said to have been derived from the Tamil word 'Bhilawar' or a bow-man. But the more we analyze the data says Majumdar, "The more it transpires that the Bhils are racially more distant from the so-called pre-Dravidian groups while they approach nearer to the higher castes. According to Rev. C. Thompson 'The Bhils form a completed arch resting upon two distinct pillars one representing the aborigines of India and the other Aryan. This view seems to be more balanced on the basis of language.

91. On the Social and Cultural aspects of 'Baidipur Sasan', Mayurbhanj District, Orissa.

B. C. ACHARYA, Cuttack.

Baidipur Sasan (21°·46′ : 86°·42′) is situated on the eastern slopes of a laterite exposure. The land is fertile to the east and rocky to the west and south. Sri Bira Baidyanath Bhanj Deo, one of the rulers of the former Mayurbhanj State was the founder of this village. He selected twelve good Brahmins from outside the state and gave them facilities to settle permanently in this village. A few Adibasis used to live in this area during that time. They helped these new comers as labourers in constructing their houses and ploughing the lands for them. Thus it grew out to be the nucleus of all the activities of the area.

The village is linear in pattern having two rows of houses, with a road in between them. It has got its temple and tank on one side, school and weekly market place on the other. Families have increased in number, lands and houses are partitioned, so new problems have crept in. People have gone outside the village to work in towns and factories. Road communication has improved with other areas during the last two five year plans. The village economy is under transformation.

Village festivals and customs still play a great part in their day to day life. The villagers and also the Adibasis have become politically conscious.

An attempt has been made in this paper to describe the social and cultural aspects of the village, keeping a view with the changing economy of the society.

92. Fire Incidence and Tile Industry in the State of Orissa.

M. M. HASAN, Cuttack.

The State of Orissa is a typical tropical country. As a result the mean annual and maxm. temperature found here is 80 and 90 degrees respectively. The rainfall over the area is equally high—about 60 inches.

These geographical factors have combined to help produce large quantities of rice all over the State. On account of the fact that the region is warm for most of the 12 months, and further, cheap and abundant availability of rice straw has a novel use of it in house roofs which keeps the dwellings cool. Hence a very large percentage of kutcha and pucca houses constructed are thatched with straw.

But straw is highly inflammable. The planning of houses are also defective. The roofs and eves are low. The use of naked flames like "Dhibri", "Dipas", and cooking at places where eves hang low are responsible for fire outbreaks.

This incidence leads to heavy loss of life and property. One of measures to check it is the expansion of Orissa Fire Service. But it is curative in nature. However, the only best preventive measure is the use of 'khapra' or tile. It is sufficiently safe against fire and commonly used in Northern India.

The Government should start tile industries at suitable points and products sold at subsidized rates.

There is one technical difficulty in manufacturing tiles from local soils as it contains a large constituent of quartz (sand). This makes tile brittle and cracks develop leading to seepage.

One of the research sections of the Central Building Research Institute, Roorkee, can solve the difficulty by evolving some formula for the necessary treatment of local soil to remove the technical difficulty.

93. A Regional Analysis of Literacy in India.

GURDEV SINGH GOSAL, Chandigarh.

With only 16·6 per cent (1951) of her people as literate, India is still far behind many of the nations of the world in literacy. For a large number of people the ability to read and write still apparently has little purpose. The salient features of literacy in India are :—(i) Literacy is fairly high both among males (55%) and females (27%) in the urban population (of over 10 years of age, 1951); (ii) regional differences in urban literacy are rather small; (iii) not only is rural literacy much lower (24% among males and 6% among females) than urban literacy but also there are significant regional contrasts in it; (iv) the male-female differential in literacy among ruralites is far greater than in urban population and there are large regional variations in the male-female differential in rural literacy; (v) in general, there is a strong inverse correlation between literacy percentage of general population and the male-female differential in it.

In this paper the discussion on regional differences in literacy in India is based on a choropleth map made from districtwise data on literacy. Although, in general, the percentage of literacy is correlated with the degree of urbanization, there are areas, such as Orissa and Assam, which are little urbanized and yet the literacy percentage there is much higher than in most areas of India. Similarly in Kerala, which is only moderately urbanized, literacy, both among males and females, is most widely spread. In the spread of literacy in these areas the contributions of the missionaries have been very great indeed.

Interestingly, nearly all the areas of lowest literacy, particularly of the rural population, are the former native states where little attention was paid toward public welfare and education.

94. Human Habitations in the Himalayan Beas Basin.

S. L. KAYASTHA, Varanasi.

Human habitations were established in the Himalayan Beas Basin long before the Aryan infiltration. Accessibility of agricultural land is the main consideration in the establishment of human settlements. Most of the population resides in rural habitations varying in size from isolated hamlets to semi-sprinkled settlements. Valley areas have small hamlets with a common village site but the mountainous parts are area of true dispersal. Some of the highest human habitations are found there. Out of the varying conditions of valleys, low hills and mountains, have developed semi-sprinkled, sprinkled and isolated habitations. Hill villages are very picturesque. There is no plan except what factors of site dictate. Rural houses are simple and built with local materials. House types exhibit the influence of local conditions and vary in each sub-region. Daulatpur, a type study, gives a general picture of a Himalayan village.

The earlier fort-site towns have decayed and new centres have developed where advantages of nodality and access exist. The raison de etre of small urban and rurban centres is their accessibility to rural areas and their function as collecting and distributing centres. Dissection of relief and inadequate communications inhibit growth of large habitations. Scattered and small village communities do not provide the sap for the growth of large urban centres; Himalayan towns still carry strong agricultural elements. Kangra provides an example of a type study of a Himalayan town. Patterns of other urban habitations are also discussed.

(v) Regional Geography.

95. Physical make-up of Central Rarh region.

S. P. CHATTERJEE and K. BAGCHI, Calcutta.

The Central Rarh Region corresponds to the lower Damodar Valley region of West Bengal limited by the River Hooghly on the east and a line joining Bishnupur with Durgapur and its continuation northwards to the West. The northern and the southern limits are constituted by the rivers Mor and Dwarkeswar in the north and the south respectively. The region permits of division into five main regions—the upland, marshes, the levee, the Doab and the Plains. The micro features and other characteristics have been discussed in the paper.

96. A Geographic Study of Gunung Kidul—a Problem area in Central Java.

M. HALIM KHAN, Aligarh.

1. In an island which is extremely fruitful, but does not enjoy high living standards, Gunung Kidul stands out for its exceptional poverty. Its topography, underground water resources, soils, vegetation, and hence, its level of living, are significantly different from the rest of Java. Moreover, this intensity of poverty is being accentuated by both human and physical factors. Forests are being mercilessly cut; farming land is being swallowed up by extending settlement and cemetries; the population is multiplying rapidly; erosion is common and pests and diseases are becoming increasingly serious for both human and vegetation. Constant reference to this area became a challenge to the Department of Gadjah Mada University, Jogjakarta.
2. The total area is about 1500 sq. km. with an average N-S dimension of 41 and E.W. of 46 kilometres. It is situated in the south eastern part of Central Java, in the autonomous province of Jogjakarta. The term "Gunung Kidul" literally means "Mountains of the South", and geologically it belongs to the upper strata of a succession of formations which comprise the southern mountains of Java. It includes an area known as "Gunung Sewu"—"Thousand Mountains"—but this is something of a misnomer, since nowhere do these uplands exceed 450 metres. Most of the topography has a limestone character, with bare karst in the south, and outcrops of volcanic sediments in the north and marl in the centre. It is essentially a land of hills and of dissected limestone hillocks.
3. The total population is roughly 500,000, but the distribution is far from uniform, the compactness or dispersion of settlement depending generally on soil types, physiography, and especially availability of water.
4. The type of land use which have developed are as follows : Out of the total area of 1500 sq. km., approximately 66 per cent is cultivated. But this figure should be accepted with caution, because the area is unlike other Japanese agricultural areas, and the problem of defining just what is a cultivated section is a real one.

   In all our estimate is that 66% is cropped
   12% is in pasture
   6% is in forest

   with the remainder being used for fruit trees, settlement, roads, ponds and graves, the latter occupying 16% of the total area.

97. Afzal Garh—a Classical Example for Development under the Community project—a Geographical analysis.

SURENDRA NATH, Varanasi.

This paper in detail includes the original research work of Geographical Analysis being carried out in the area, and the effect of planning on the conditions. Geographical Analysis describes the conditions (Physical, Cultural and Landuse) prior to the Block, Conditions after opening the block and achievement by the Scheme with some suggestions to improve the planning.

Afzalgarh Block of Bijnor District furnishes an excellent spot for the study of geographical problems. The physical factors have played a great role in making this area infertile and barren. Ram Ganga and its numerous tributaries (Hill-torrents) which carry little water throughout the year but are subject to heavy floods in rainy season make the communication difficult, cause to the Soil Erosion and convert the land into marshyland. Geologically the area is also peculiar having no Terai belt between Bhabhar and Bhangar. Climate is also uncomfortable and causes to many diseases. The area was most backward in the field of Education prior to the envisage of the Block and still it is. Standard of living is humble, better than Eastern U.P. Inspite of several streams and hill torrents, the problems of scant irrigation facilities exist and no improvement is visible.

Though the Extension Services had done much for this area, yet the area is not much benefited and is still a backward one in all respects. The reason of the failure may be the negligence of the Geographical Factors in planning. The man is slave of the environment, but the environment factor is generally discarded.

After considering all these factors, in the end the author has suggested about 22 suggestions for improvement of the planning.

The present work leads to conclusion that the planning must be done after analysing the area geographically and it must be done on Block-level instead of District-level. Construction of Kalagarh Dam is most necessary. Geographical analysis of every block before starting the developments is most necessary. Planning should be done and carried out by technical persons such as Geographers, Agriculturists etc., because Geographical factors play a great role in making the area.

(vi) Land Use.

98. Changes in the pattern of arable land in Chakia Tahsil of Banaras District (U.P.).

BASANT SINGH, Varanasi.

The study relates to the changes in the pattern of arable land on Vindhyan plateau as well as Ganga plain of Chakia.

Since 1880-81 old and new fallows have almost disappeared from the area due to the pressure of ever increasing population and the rise in prices of agricultural commodities. The development of irrigational facilities have also encouraged to bring more land under the plough. The marginal lands too, have proved profitable for cultivators. The virgin lands in the open forests have also not been kept out of cultivation. From the agricultural records of 1948 it is obvious that as many as 17 new villages have been established on the Vindhyan plateau, which are producing mostly food crops.

It is striking to note that some of the very important crops like indigo and opium have disappeared and sugarcane is gradually diminishing in importance; their place is being taken by food crops. Owing to increasing irrigational facilities the double cropped has increased. It may be remarked here that not only the acreage under food crops but also the yields per acre have considerably increased.

99. Moradabad district Changes in Land Use.

S. L. DUGGAL, Muzaffarnagar.

The main land use categories found in this district are (a) Arable Land, (b) Groves and Orchards, (c) Waste land or banjar, (d) Land under water and (e) Land agriculturally unproductive. There is little forest and little grassland. A thousand years ago, there used to be much forest but it has been reclaimed for settlement and cultivation during the course of time.

The arable is the predominant type of land use and nearly 85% of the total area of the district falls in this category, while 1% is under groves and orchards, 5% is wasteland or banjar, 3% is under water and 6% is under settlements, roads etc. The old fallow has been totally reclaimed. The wasteland, land under water and grove land used to be more extensive formerly, but these categories of land have also been reclaimed. But the land agriculturally unproductive is increasing at a rapid rate owing to the development of settlements and means of communication.

100. Historical Evolution of Land Use in Nova Scotia.

SAVITRI G. BURMAN, Delhi.

Use of land in Nova Scotia, in its type and intensity, has been very greatly influenced by its location, in addition to the other physical attributes of the land, and the advance in technological developments. Its location as regards Europe, New England, and other population centres of Canada has influenced, both directly and indirectly, the evolution of its land use in its broad aspects as well as details, by very largely directing the history of its settlement and the origin of its population.

Because of being the centre of arena of struggle for possession of North America between England and France for a century and a half, the only settlement made was by a small group of the French, who were later turned out. Settlement in Nova Scotia in earnest began only after 1760. From those days, the land use in Nova Scotia has changed vastly, in detail, when the emphasis was on growth of grains, fibres for clothing, wild products of the woodland, and the sea. After passing through various stages of grain production, livestock production, lumbering and allied activities, it has evolved into a dairy economy, with production of fruit, vegetables, poultry and eggs on good and sub-marginal agricultural lands, abandonment of marginal agricultural lands to woodland, and new types of land use in mining and recreation lands.

101. Land use characteristics in the West Hooghly Conurbation Belt.

S. P. CHATTERJEE and K. BAGCHI, Calcutta.

The Hooghly Conurbation belt West was studied in field and the information obtained was analysed. Though conurbation is usually intended to apply for areas where a continuous series of dwellings, factories, harbours and docks, urban parks and playing fields etc., which are not separated by rural land though in many cases such urban area include enclaves of rural land which is still in agricultural occupation are found, there is no such thing as a typical conurbation in West Hooghly Belt. It does not consist everywhere of well integrated towns. Rather one notices a series of sprawling industrial areas tied for social purposes into administrative parcels labelled urban municipalities. The percentage of break up of land for different categories of area has been provided. An indication has been given that there is a trend for a continuous belt to evolve by incorporation of existing blanks in an unplanned manner which will worsen the existing problems of drainage, water supply, transport and congestion.

(vii) Urban Geography.

102. Karwi—a Geographical study.

NARAYAN PRASAD, Allahabad.

The present paper attempts an analysis of the evolution and morphological development of Karwi, a town in Banda district of Uttar Pradesh. Karwi, a railway station on the Manikpur-Jhansi section of the Central Railway, is located on the bank of the Paisuni, a tributary of the Jamuna. The Vindhya hills in the south are not far from here and Chitrakut, the famous place of pilgrimage is only a distance of 3½ miles. The settlement was founnded as a colony of Brahmins some 300 years ago. Since then, the colony had been under the suzerainty of the "Mahant" of the 'akhara' of Jagannath and Amrit Rao and Binaik Rao. From a village of only 6,054 souls in 1865, it has now grown into a town of more than 15,000 persons consisting mainly of low castes with few Brahmins, Rajputs and Vaishyas.

The former Karwi Notified Area included Purani Bazar, Naya Bazar and Tarahuwan consisting in 6 mohallas. Only recently the nearby settlement of Sitapur was combined with Karwi to form the present local authority named as the Chitrakut Dham Nagarpalika. The social institutions of the town include several educational institutions, a dispensary, temples and Dharmshalas. It houses several government offices and is the seat of sub-divisional administration. The industries and manufactures of the town include stone-utensils, glass and lac bangles, wooden toys and 'biri' manufactured from indigenous 'tendu' leaves. It is an important marketing centre for food-grains, oilseeds, ghee, mahua, sugar and hides and skins. The Allahabad-Banda road passes through this town.

Karwi is a growing town and has vast potentialities conditioned by active public participation and adequate government aid for its development. Electric supply, water supply, drainage and sanitation and improved roads are its immediate needs.

103. The Tributary Area of Baroda.

V. A. JANAKI and M. C. GHIA, Baroda.

The paper critically examines the nature and extent of the tributary area or the city-region of Baroda. The indices used are high school education, medical and newspaper services, transport frequencies, industrial labour, vegetables and milk supplies and the weekly market service. The nature and shape of the city region depend on the size and function of the town, the transport facilities in the region, the commercial facilities presented by the country side, the degree of economic activity of the city as compared with the neighbouring towns and cities, its political, cultural and historical associations with the region and general lay out of the country. The slow growth of urbanism and the traditional self-sufficiency of the village in India, together with the inadequacy of transport and lack of specialised services in towns have restricted the town's influence over the region. The city is not a dominant feature in the cultural landscape of India. However with rapid industrial development the city and its region will assume greater significance and an understanding of this town-country relationship will be necessary for regional economic planning.

104. External Transport of Cuttack City.

RABINDRANATH RAY, Cuttack.

The transport of Cuttack city may be discussed under two separate heads. These are external and internal. In this paper an attempt has been made to study the external transport of Cuttack city.

Inspite of its wonderful position at the apex of the Mahanadi delta riverine traffic is practically unimportant here due to a number of geographical factors. These are (1) the nature of the river bed and the volume of water in rivers, (2) the presence of sand bars at the river mouths, (3) presence of mangrove swamps, (4) destructive cyclones, (5) heavy floods.

Land connection of some sort existed during the Muslim and Marhatta periods. But roads were unpaved, bridges were few and journey was slow and risky. The backwardness of road connection was due to a number of geographical and political factors. Among the geographical factors are (1) the natural isolation of the district, (2) presence of innumerable rivers in the deltaic section, (3) muddy soil, (4) difficulty of getting road building metals. Among the political factors the most important is the constant neglect of Cuttack and Orissa as a whole, in periods when the province was either conquered or attached to other States.

Lots of improvement have taken place in the external communication of the city, but still more is needed. Development of external transport is suggested on the following lines (1) starting of a duplicate Howrah-Puri express and a shuttle service between Bhubaneswar and Choudwar, (2) proper paving and widening of roads connecting Cuttack with small towns and villages in the delta, making them suitable for heavy traffic movement, (3) deepening and widening of canals and making them suitable for launches and boats.

105. Evolution of Towns in the Upper Damodar Basin.

HEM PRIYĀ DEVI, Varanasi.

Every region records the hours of development when man develops his intimacy with it. The region may have variety of treasures over its surface and in its inner vaults but it is man's accomplishment that motivates him to change the face of the country by testing his accomplishments in relation to the potential resources of the regian concerned. The Permian-Triassic trough of the upper Damodar is one such region of great potentiality. The Damodar along with its tributaries was busy in washing the treasured wealth unnoticed and unhampered. This virgin countryside went on unwedded till the first axe of the aboriginal broke its silence. With this early phase of man's punctuation, the region started to time the different phases of developments.

Industrialisation has greater relation with the multipurpose project of the Damodar which is a very significant phase in inscribing new cultural land scape. The Damodar and its major tributaries have been dammed at convenient points like Tilaiya, Panchet, Maithon, Konar with urban outlook. Other towns like Bokaro Sindri, Gumia with industrial activities have been grouped in the list of towns. The future steel town of Bokaro would be a new urban dot on the Damodar Valley map.

All the new towns which have come into existence are the outcome of the damming of the Damodar along with other factors.

106. Population Growth of Jhansi.

J. P. NAGAR, Allahabad.

In the present paper attempt has been made to discuss some characteristics of the population growth of Jhansi. Although the town dates back to 1583 A.D. yet no early census records are available. In 1857 the town was one of the richest cities of central India with about 60,000 souls. In the First War of Indian Independence the British forces razed the city to the ground and slew most of its inhabitants. Several thousands left the town out of fear. After 1857 the total population was reduced to 7,000. According to Atkinson's estimate of 1881 the total population of Jhansi was 32,987 which rose to 76,126 in 1911. It recorded a decrease of 2·6% during 1911-21. It is significant to note that during 1921 the percentage increase was higher than that of any Kaval town of U.P. In 1941 for the first time the population of Jhansi exceeded one lakh mark. During 1951-60 the population of town rose by more than 33% and the city's rank became twelth amongst the towns of U.P. which was fourteenth in 1951. The universality of marriages, high proportion of married women, and unpopularity of family planning accounted for high birth rates. While lack of medical facilities and ill-sanitation, famines and other natural calamities were responsible for high death rates. Jhansi attracted a large number of immigrants due to increased employment opportunities in the wake of decaying native industries and old trade routes in the surrounding area.

107. Some recent trends in the growth of population of Allahabad.

R. L. DWIVEDI, Allahabad.

In any scheme of town planning the usefulness of population analysis needs hardly any over emphasis. The present paper attempts to discuss some of the recent trends in the growth of population of Allahabad—one of the five Kaval towns of Uttar Pradesh, India. In the present century city's population has risen by about 150% (1901—172,000, 1961—432,000). However, the growth has not been continuous. The first two decades witnessed a slow and steady decline of the population while since 1921 it has indicated a well-marked upward trend. The city, which ranked fourth among the Kaval towns in 1891 has always been fifth since 1901. It lost its rank as one of the fifteen largest cities of India in 1921. Three factors are mainly responsible for swelling of numbers. (1) Natural increase, (2) Immigation and (3) extension of municipal limits. Significantly the population has risen more through immigration than through natural increase during 1921-50. The last factor accounts for substantial increase in the 1961 population, because limits of the city were greatly extended in 1956 and again in 1959 to raise the city municipality to the status of a Corporation. (The Municipal area prior to Oct. 1, 1956 was 15·94 square miles; on Feb. 1, 1960 it stood at 24·2 sq. miles). All the three factors of growth have been fully discussed in the paper.

108. Functional Topography of Bhagalpur.

S. P. SINGH, Varanasi.

Bhagalpur, headquarters of Bhagalpur division, Bihar, lies on the southern bank of the river Ganga (25° 15';. 87° 0'E). Bhagalpur is essentially a large urban amalgam of multinuclear character and displays various clusters tracing their origin in the ancient, medieval and modern growths with vast interstitial spaces throughout the urban landscape. A close study reveals that (1) The core of the commercial activity coincides with the new heart of the city; the Sujaganj, (2) Some new shopping parades have grown up mainly along the main roads, (3) Most of the wholesale shopping parades are located in the main commercial area, (4) The grain and meat markets show a peripheral location.

Educational institutions are scattered throughout the city but are large educational zone has developed south of the Tilha Kothi. Generally all administrative centres are located near sandis compound.

Quite naturally the Bhagalpur Railway station area has attracted the location of industrial sections of the city, both in the north and south.

Agricultural lands are found in the interstital open spaces as well as on the periphery.

Based on the functional character of different parts of the city, the area can be divided into functional regions. (1) Residential area, (2) commercial area, (3) educational area, (4) administrative area, (5) industrial-cum-residential area and (6) agricultural area.

Thus it is mainly a commercial-cum-administrative centre.

109. Demographic Structure of Visakhapatnam.

B. P. RAO, Varanasi.

Visakhapatnam, one of the six major ports of India, is located on the East coast in the middle of Calcutta and Madras. Its rapid economic and commercial growth during last fifty years has brought a distinct change in the demographic structure of the town.

Though the town was refounded in the 17th century, its growth was slow till the first decade of the present century. The town saw a very rapid growth of population during the last 80 years (585 per cent). Indeed this rapid growth was experienced after the opening of the modern harbour in 1933 and establishment of the University and other social institutions in the same decade. After the establishment of the large and small scale industries, during the last decade, the growth of population has again received a strong momentum.

The present population of the town is 207,506. The distributional pattern of population shows a distinct departure in the density in different areas of the town. In some parts of the old town the population has decreased whereas the thinly populated areas show a marked increase in density. The lack of space in some parts of the old town has created slums which inhabit 40% of its population. Likewise the livelihood pattern also shows a marked departure due to the establishment of new industries, increased port activities and opening of private and public offices. The increased urban activities and limited urban amenities have created many problems which invite immediate attention.

110. Geographical zones of Murshidabad.

N. D. BHATTACHARYA, Varanasi.

The object of the present paper is to focus attention on the 'Geographical Zones of Murshidabad'. The present townscape represents different geographical personalities in its nature and character of roads, type and density of houses and general pattern of land-use. Keeping these points in view, mainly three 'Geographical Zones of Murshidabad' may be thus distinguished : (i) the inner zone, (ii) the middle zone, and (iii) the outer zone.

Murshidabad-on-Bhagirathi (24° 12' : 88° 17'), one of the decayed historical cities in West Bengal, lies at a distance of 197 kilometers (122 miles) north of Calcutta. The city was the regional capital of Bengal, Bihar and Orissa during the Moghal period. The geographical factors like site, situation and topography have played their significant role in shaping the social and cultural landscape of Murshidabad.

The inner geographical zone consists of the areas surrounding the Killa-Nizamat as nucleus. There are many palatial buildings, mostly characterised by Muslim designs of mediaeval times. The river-front presents a picturesque aspect.

The middle zone shows a transitional character. Its outer limit is now and then irregular and does not follow any definite boundary. The influence of modernity can be visualised in the immediate vicinity of the Lalbag Court.

The outer zone covers a considerable area from Akbarpur to Moti-Jhil. The cultural landscape of this zone is now characterised mainly by the ruins and remnants of the mediaeval period and hamleted settlements are enveloped by jungles. With the introduction of electricity, a phenomenal change is visualised.

111. Port-Blair—a study in its external and internal relations.

PARMANAND LAL, Varanasi.

Port-Blair (11° 41'N-92° 46'E) is situated along the east coast of the Andaman Islands that are spreading like beads in the blue waters of the Bay of Bengal between 6th and 14th parallels. It is the leading port, the only town and the capital of the Andaman and Nicobar group of Islands.

Port Blair started as a colony with 200 free settlers in the year 1789 established by Captain Archibald Blair of the Royal Navy. In 1857 Port Blair was selected as a Penal Colony which gradually changed into penal settlement with a large number of term convicts from all parts of India and Burma. After independence, Port Blair has become the seat of commercial, industrial and social activities. The present population of the town is 19,000 consisting mainly of Civil employees and traders.

Port Blair maintains her external relations with India and export timbers, match splints, shells, coconuts, copra, rubber and betel nuts. The chief commodities of import are machinery and stores, petroleum products, piecegoods, cereals, cement and building materials from India. The export and import figures totalled 32,735 metric tons in the year 1959-60. It communicates with its hinterland by metalled roads and inter-island transport ships.

112. 'Kaval' towns : A Comparative Study in Functional Aspects of Urban Centres in Uttar Pradesh.

UJAGIR SINGH, Varanasi.

All the five great cities of Uttar Pradesh are river-side towns situated on navigable water channel serving as a source of water supply and water barrier in front, in the centre of Indo-Ganga Plain rightly called 'Madhya Desh' by the Aryans. They possess the advantage of a wide variety of physical endowment characterised by diversity and accessibility. These advantages of site and situation have made the 'Kaval' towns large urban centres. The population of Kanpur

(947,793) has now reached about a million figure. Lucknow (662,196), Varanasi (573,558), Agra (509,108) are well above half a million, while Allahabad (431,007) has nearly half a million population.

Of five cities, only Kanpur with 42 per cent of population engaged in industry is an industrial city. Lucknow, the capital of Uttar Pradesh with 48·8 per cent engaged in services etc. is an administrative centre. The historic towns of Agra and Allahabad are the old capitals of Uttar Pradesh where more than 40 per cent people are engaged in services etc. They are mainly tourist and administrative centres. Varanasi, with 34·4 per cent in industry, 24 per cent in trade and 31 per cent in services, is a multi functional town.

Zonal distribution of functions of these towns follows more or less the same pattern but greatly differs in details influenced and modified by the physical terran of the site, economic resources of the umland and the historic and cultural traditions of which these cities were the centres. The influence of peninsular character of site of the confluence town of Tirth Raj Prayag (Allahabad), of the crescent shaped Ganga along the Kankar ridge in the sacred city of Varanasi, of the historic remains of the Mughals in Agra, Nawabi traditions and culture in Lucknow, and the impact of rapid industrialisation in Kanpur are clearly marked in the functional landscape of those cities.

(viii) Cartography.

113. Some Problems of Cartographic Generalization.

SIVAPRASAD DAS GUPTA, Calcutta.

Generalization is a fundamental keynote in geographical mapping. A map not only makes a graphic representation of various geographical data but also interprets them through the processes of systematic generalization. In applied cartography several practical problems of generalization are met with, relating to the various kinds and degrees of generalization.

On analysing the different principles of cartographic generalization, it is found that it can be divided into two basic types : (a) physical and (b) classificatory. Physical generalization is largely of qualitative nature and involves the various processes as follows : (i) methodical elimination of unimportant items on maps, (ii) simplification of patterns, (iii) emphasization and exaggeration of important features, (iv) symbolization and diagramatization of items not plottable to scale, etc. Classificatory generalization entails application of various cartographic devices and processes of quantitative nature such as (i) selection of data, (ii) analysis, synthesis and grouping of data, (iii) statistical manipulation of figures, (iv) geographic regionalization, (v) elimination of anomalous data, (vi) adoption of suitable standards, criteria and datums, (vii) approximation of data, (viii) interpolation and extrapolation of data etc.

In application of principles of generalization to cartography, the problems relating to degree of generalization are important. It is quite difficult to strike a balanced degree of generalization on a map, taking into consideration its scale, purpose and the various cartographic limitations in relation to the available mappable data, so as to avoid the common defects of over-, under-, unequal and hasty generalization. Attempts have, therefore, been made to find suitable measures of the degree of cartographic generalization, both quantitative and qualitative. Cartographic generalization also results in certain amount of errors and approximations on maps; the problem of possible minimization and distribution of cartographic errors has also been investigated.

114. Application of Lambert's Conical Conformal Projection in the National Atlas of India.

NANHE LAL, Varanasi.

In this paper an attempt has been made to assess the preference of Lambert's Conical Conformal Projection for the maps (India) of the National Atlas of India, published in 1957. This projection represents, undoubtedly, a good compromise between the homolographic and azimuthal properties as compared to other universally applied projections, such as Polyconic, for the maps of this country. Percentages of scale errors, farthest from the standard parallels, have been pointed out. This projection, in addition to its wide use during the First World War, was also used for some maps in the Debes' Atlas. The author is, however, of the opinion that the Atlas, being also a source of information for the suitability of various projections for different purposes, would have enhanced its usefulness and educative value by applying some other suitable projections, viz. Oblique Azimuthal Equal Area, Conical Equal Area (Alber's) etc. for the distribution maps. A set of well chosen projections would have served better.

115. Error in Mapping by Isopleth and Choropleth methods.

R. RAMACHANDRAN, Dharwar.

The quantitative distribution maps do not generally represent all the minute variations in a real distribution and therefore involve a certain error. This paper attempts to give a clear definition of this error in quantitative terms.

The process involved in mapping by the choropleth method is essentially a process of continued dichotomy. By this process a region is divided into a number of subregions. A subregion is an area which is geographycally contiguous and wherein the value of the criteria mapped remains within specified limits. A subregion may comprise one or more basic units. Subregions are the final product of mapping and the number of basic units definned in a map will depend upon the number of basic units in it. But by choosing a smaller basic unit it will be possible to define a greater number of subregions. The number of subregions that can be defined by choosing the smallest conceivable basic unit may be called the ultimate number of subregions. The difference between the actual number of subregions and the ultimate number of subregions gives the absolute error in mapping.

Having thus defined the error in mapping, the various factors which contribute to error in mapping are analysed. The important factors are : the size of the region mapped, the homogeneity of the region and the number of basic units used in mapping. The conclusions are summarised in a mathematical form.

116. Statistical Methods in Geography.

M. P. SHREEVASTAVA, Dharwar.

A case has been made in this paper for including a full-fledged paper or practical (dealing with statistical techniques) in post-graduate curriculum for geography at the Indian Universities. Just as a theoretical background of a well-trained geographer consists of an understanding of fundamental principles of many social and physical sciences, he should also be grounded in practically every important technique of problem-oriented research.

A research paper or a thesis or a report by a geographer must be acceptable, if it makes use of only statistical tables and statistical analysis, without any maps to go along. More frequent employment of the statistical methods would bring a geographer on par with other social scientists such as economist and sociologist. Maps, which in many cases repeat the statistical analysis, would better is eliminated. Statistics must play an increasing role in the training of geographers.

(ix) Soil Geography.

117. A note on the Physico-Chemical, Textural and Production Potential of Soils in Kashmir valley.

A. N. RAINA, Jammu.

The paper is a reconnaissance survey undertaken to prepare a gemorphic map of the Valley of Kashmir to demarcate the soil boundaries so far as possible. The entire valley of Kashmir, an area of about 8,539 square miles surrounded by the mountains is drained by the Jhelum River and its tributaries. As the altitude rises there are varied soil types from stiffest clay to highest loam yielding a rich harvest.

From Kulgam to Handwara, about 5000′ above sea level (32°17′N. to 36°48′N. and 73°26′ East Longitude to 80°30′ East Lonfitude) is often flooded in spring and autumn upto 6000′ contour that forms an irregular circle passing through Chasmashahi, Dara, Kangam Manasbal, Ajas, Aragam, Sonarwan, Magam, Bumai, Lunderwan, Braman and Sonapath. The area within this flood-contour looks like a mushroom cloud with its tail tapering towards South.

The silt index of the Jhelum River varies in mean diameter from 1·0270 mm. at Sangam to 0·4830 mm. at Naiyon where the Vishav and the Rambiara join the Jhelum.

A field analysis of some of the soil samples reveal colour texture, chemical constituents and respective richness as the altitude rises. Thus a study of the soil nutrients has helped in land utilization. These soil samples are from areas above 6000′ contour revealing that the organic matter decreases in percentage as the altitude rises and the water-holding capacity as well. The results of the examination from the samples show that the soils are degraded podzols and that cultivation is possible even at very high altitude.

An attempt has also been made to correlate, so far as possible, a high density of population in these cultivable alluvial lands to their production potential. From field surveys and spot interrogation the wisdom of centuries preserved in adages revealed an appreciation of practical knowledge of some of the important agricultural operations.

SECTION OF BOTANY

President : PROF. J. VENKATESWARLU, D.Sc., Ph.D.

Abstracts.

Algae

1. The Compsopogonales in India.

C. R. DAS, Calcutta.

Three species of *Compsopogon* have been studied,—2 of which have already been described by previous workers and one has been discovered. The new report of this freshwater red alga has been described as *C. indica* Sp. nov. is quite distinct from other reported species and has been worked out in greater detail.

Compsopogon is the freswater genus of the family Compsopogonaceae belonging to the order Compsopogonales the members of which are found growing in fresh-water habitat. It has been placed in the Uncertain Bangiales,—an undecided systematic position among the members. An idea of its taxonomy has been drawn in the paper, with a key to the reported species from India. The report of tetrasporangium in *Compsopogon* is also for the first time from India.

An oil of vigilant interest on chemical analysis has been obtained from a species of *Compsopogon* and as such the genus has been put to further inquiry.

2. Further study of the Algal Flora of Cuttack.

H. PATTNAIK and B. N. MISRA, Cuttack.

The drains of Cuttack, which are poorly maintained, are the good habitats for the algal flora to flourish well. There are a large number of ditches and ponds which collect rain water and are also suitable habitats for the algal flora. In this paper 20 species of different groups of Algae have been described. Among the different groups Chlorophyceae has the largest number of species and Bacilariophyceae has been represented only by Diatoms of different sizes belonging mostly to Pennatae.

In summer the organisms remain in zygote stage or in a resting stage. At the beginning of winter, when the water remains almost stationary, the Algal flora flourishes well. In spring season maximum development of the Algal vegetation can be seen.

3. Diatoms from the Pleistocene Clay Deposits of Kashmir. Part II. Pennate Diatoms.

A. R. RAO and PRITI AWASTHI (MISS), Lucknow.

The present communication, describes, figures and lists the species of Pennate diatoms occuring in some Pleistocene clay deposits of Kashmir (INDIA). Most of the specimens are fragmentory. Descriptions are based on the most perfect specimens occured in the clay. Provesional identifications show that the assemblage covers at least eleven genera, specific identification of these are in progress, following are the genera *Fragilavia, Caloneis, Navicula, Pinnularia, Epithemia, Hantzschia, Diploneis, Eunotia, Cocconeis, Gyrosigma* and *Cymbella.*

4. Diatoms from the Pleistocene Deposits of Kashmir (India). Part I. Centric Diatoms.

A. R. RAO and PRITI AWASTHI (MISS), Lucknow.

Although the Pleistocene microfossil flora of Kashmir has been investigated by various workers after the discovery of Godwin Austen (1859). Not much has been done on its flora. Cogner (De Terra and Pattersen) recorded some diatoms from the Pleistocene deposits of Kashmir. In the present investigation two clayey blocks obtained from a new locality laradura were analysed. The centric diatom so far identified, have been described and figured, are *Melosira ambigua, Melosira sp. 1, Melosira sp. 2, Melosira sp. 3, Cyclotella meneghiniana, C. comta, C. Comta var affinis, C. iyengaria* sp. nov, and *Stephanodiscus astraeae.* Most of these are fragmentory but some of these complete frustules admit specific identification.

Mycology and Plant Pathology.

5. Fungi causing plant diseases at Jabalpur (M.P.). VIII.

G. P. AGARWAL, Jabalpur.

The present paper describes five more parasitic Deuteromycetes causing leaf spot at Jabalpur. *Phyllosticta hasijai* Agarwal on *Acacia melanoxylon* R. Br. and *Cercospora anisochilicola* Agarwal on leaves of *Anisochilus eriocephalus,* are the two new species described in detail. *Phyllosticta hasijai* sp. nov.—Pycnidia fusce brunnea, globosa vel lenticularia, ostiolata, 46·5-245 μ diam., mediet. 167·7 μ ; conidia hyalina, unicellularia, ovalia vel cylindrica, 3-18·3 × 2·9-3·1 μ, mediet. 6 × 3 μ. *Cercospora anisochilicola* sp. nov.—conidiophori fasciculati, evoluti ex stromatibus densis, erecti, simplices vel furcati, septati, geniculati, 25·6 – 102·4 μ longi, mediet. 89·6 μ ; conidia hyalina, filiformia, recta vel curvata fastigata in apicem terminalem, 2—16 septata, cicatrice monstrante punctum unionis praesente ad basin, 32—154·4 × 3·2 – 5·6 μ, mediet. 85·5 × 4·5 μ. *Cercospora fasminicola* Mueller & Chupp on leaves of *Jasminum* sp. and *C. achyranthina* Thirum. & Chupp on leaves of *Achyranthes aspera* are two new records for the State and *Pestalotiopsis glandicola* (Cast.) Steyaert on leaves of *Cassia tora* L. is a new addition to the fungus flora of India.

6. Studies on the Fusarium Wilt of Ipecac in the field.

H. K. BARUAH, MUNIN CHETIA and G. SATYANARAYANA, Gauhati.

Psychotria ipecachuna Stokes, commonly known as Ipecac, belongs to Rubiaceae. It is a well-known medicinal plant valued for the many alkoloids of which Psychotrine and Ematine are the most important. It is introduced into Assam recently and is cultivated at Nangpoh in the Khasi and Jayntia hills. The plants at the sight of cultivation were reported to be dying after developing a wilt symptom in the field. The present investigation deals with the identification and isolation of the pathogen from the wilted plants. The pathogen is identified to be the soil-born *Fusarium solani.* The pathogenicity experiments conducted with the organism isolated from the wilted plants produced disease symptoms similar to those observed in the field. Control methods are under progress.

7. Field observations on the incidence of *Fusarium* Wilt of gram *(Cicer Arietinum* L.) in relation to soil conditions.

S. K. CHAUHAN, Agra.

The observations were recorded at B. R. College, Bichpuri Farm, Agra pertaining to soil temperature, soil moisture, soil pH and disease intensity in two fields (healthy and diseased) simultaniously at regular intervals of fifteen days during the period of optimum disease development in relation to wilt of gram *(Cicer arietinum* L.) caused by *Fusarium orthoceras* var *ciceri.* It has been noted that for a considerable long period of the crop the soil temperature ranges (24°-28°C) were present in wilt affected field as also observed by Jones *et al* (1926) for other vascular wilts. However, no significant relationship has been observed between the wilt incidence and soil pH and moisture of the fields. It seems that various soil factors act jointly and interact as pointed out by Rishbeth (1955) in Pannama disease. The tempo of disease is studied by appraising its intensity at the same regular intervals. Further, it may be pointed out that frequency of population of *Fusarium orthoceras* var. *ciceri* was almost negligible in the soil of healthy field and abundant in diseased one under observation.

8. Role of soil organic matter (Humus) in wilt of gram *(Cicer Arietinum* L.) caused by *Fusarium Orthoceras* var. *Ciceri.*

S. K. CHAUHAN, Agra.

Wilt of gram (*Cicer arietinum* L.) caused by *Fusarium orthoceras* var. *ciceri* has been studied in relation to soil organic matter (humus). The percentage humus was altered by adding municipal compost in soil in various proportions, and humus percentage in five such samples was determined as suggested by Wakesman (1952). The values being 16·40, 13·70, 12·53, 11·00 and 8·27% humus content. Soil of these samples was filled-in in pots and infested with the pathogen and then 7 seeds were sown in each pot. Six replications of infested and noninfested (control) were kept.

Final mortality figures were recorded in each pot of each treatment and the data analysed statistically. However, no plant wilted in the control. By changing the percentage humus content of soil the ptrcentage mortality also changed. The percentage mortality is inversely proportional with the percentage amount of humus in the soil. The order of reduction being 90·51 > 69·11 > 57·20 > 38·13 > 19·11 in various combinations respectively. As the data found to be statistically significant the C.D. was also calculated, which was 16·36.

9. Effect of soil moisture on the incidence of fusarium wilt of gram *(Cicer Arietinum* L.)

S. K. CHAUHAN, Agra.

Influence of four leavels of soil moisture, well within the water holding capacity, viz. 10, 15, 20 and 25% (on oven dry weight) was observed on the wilt mortality in gram (*Cicer arietinum* L.) caused by *Fusarium orthoceras* var. *ciceri.* Weighed glazed metal pots were filled with 6 lbs. of soil and various moisture levels were maintained by weighing. The soil was infested in the usual way and five seeds were sown. Six replications were kept throughout the course for each treatment and its control. The data obtained on final mortality were analysed statistically and found to be significant.

The maximum percentage mortality of 83·33 was at 25% soil moisture level and it decreased considerably in lower levels. The order of reduction in the percentage mortality being at 25%—83·33 > 20%—36·66 > 15%—26·66 and at 10%—13·83. The C.D. for the figures being 14·71.

10. Studies on Penicillin—IV. Utilization of Monosaccharides by Some Non-overticillate Penicillia.

DINESH KUMAR, Allahabad.

The utilization of some monosaccharides given alone and in mixture with sorbose were studied in the case of *Penicillium levitum* Raper and Fennel, *P. sclerotiorum* van Beyma, *P. citreo-viride* Biourge and *P. cyaneum* (B. and S.) Biourge. Where as maximum yield was obtained on fructose, sorbose was found to be the poorest of all sources tried. The behaviour of these molds was different on rhamnose as compared to arabinose and xylose, presumably due to presence of CH^3 group in it. Whereas glucose and galactose were better utilized in the presence of sorbose, the utilization of fructose, xylose and arabinose was inhibited in general. Only *P. citreo-viride* could utilize all the monosaccharides better in presence of sorbose.

11. Newly reported fungi from Orissa—I.

G. R. GHOSH and B. G. DUTTA, Cuttack.

I. *Tryblidiella rufula* (Spreng.) Sacc. on *Citrus aurantifolia* (Christm.) Swingle and *Citrus* sp.

The fungus has been found growing on dead twigs of *Citrus aurantifolia* (Christm.) Swingle at Cuttack and *Citrus* sp. at Barang.

Apothecia loosely scattered to gregarious, erumpent then superficial, elliptical ovate, opening by a cleft, hard, black, 1-2 mm long × 0·5-0·8 mm broad; stroma lacking; hypothecium well developed, thick; asci cylindric, 8-spored, 105·5-122·4 × 9·5-12 μ; paraphyses numerous, hyaline, mostly unbranched, but sometimes branched at the tip; ascospores oblong ovate, straight, sometimes slightly bent, uniseriate, mature spores three septate, slightly constricted at each septum, 20·5-23×7-8·5 μ, smoky, smooth, thick walled, dispersing at maturity through an apical pore in the ascus.

2. *Trabutia butleri* Theiss & Syd. on leaves of *Ficus religiosa* L.

Perithecia epiphyllous, sunken in stroma, reduced to polyascous locules with ostioles; stroma irregularly disposed on the leaf, sparse to gregarious, 6-17 mm in extent, plano-conves, black, sinuous, forms a shield shaped black mass around the perithecia resembling a clypeus; asci cylindric ovate, 48159 × 18-24 μ, interspersed between numerous slender, long, hyalin paraphyses; ascospores hyaline, 1-2 seriate, elliptical to pyriform, 14·5-18 × 9·5-12 μ.

The authors wish to thank Dr. J. C. F. Hopkins, Director, Commonwealth Mycological Institute, Kew, England, for kindly identifying the fungi.

12. Newly reported fungi from Orissa—II.

B. G. DUTTA and G. R. GHOSH, Cuttack.

1. *Fruit rot of pome granates.*

Fruit rot of Pome granate (*Punica granatum* L.) as reported here from Bhadrak, District Balasore, is caused by a fungus identified by the authors to be *Aspergillus* *foetidus* Thom & Raper. The fungus was cultivated on Czapek's solution agar. Cultural, morphological characters and mode of infection etc. are described in details in the paper.

Fruit rot in Pome granates has been reported previously from India by Butler (1914) who states the fungus responsible as *Aspergillus castaneus* Patterson. In Saccardo (1902) the fungues is named as *Sterigmatocystis castanea* Patterson, but Thom and Church (1926) state this fungus to be a strain of the *Aspergillus niger* group. The disease under report is caused by a fungus which is also a member of the *Aspergillus niger* group but is not *Aspergillus castaneus* Patterson, as reported previously.

2. Seedling blight of *Ipomoea carnea* Jacq.

Seedling blight of *Ipomoea carnea* Jacq. is caused by *Fusarium nivale* (Fries) Cesati. The fungus makes its first appearance on the host only after the seed coat has broken apart (treatment by B. Misra, Cuttack) and the radicle has just started to come out. Slimy spots appear on cotyledons, seed coats and radicle. The radicle gets rotten first leading to the death of the seedling. In late invasions, the first two leaves and others are also attacked. The fungus was cultivated on Czapek's solution agar. The morphological and cultural characters are discussed in detail in the paper.

13. Myxomycetes from Orissa.

G. R. GHOSH and B. G. DUTTA, Cuttack.

The following Myxomycetes have been collected and identified from Cuttack, and are being reported for the first time from Orissa, the asterisked ones are new additions to Indian Myxomycetes.

1. *Arcyria cinerea* (Bull.) Pers.
2. *Hemitrichia stipitata* (Massee) Macbr.
3. *Diachea leucopodia* (Bull.) Rost.
4. *Phyasarum nicaraguense* Macbr.
*5. *Stemonitis flavogenita* Jahn.
*6. *Didymium vaccinum* (Dur. & Mont.) Buchet.
*7. *Didymium minus* (Lister) Morgan.
*8. *Cribraria splendens* (Schrad.) Pers.
*9. *Elaeomyxa* sp. (described below).

Habitat : on dead rotten wood.
Plasmodium : not observed.
Fructification : sporangiate.
Sporangia : gregarious, stalked, cylindric, apex-obtuse ,dirty white, iridescent, up to 1·5 mm long; stalk long, erect, black; columella limeless, almost black, about half the height of the sporangium, swollen at the tip.
Capillitium : arising mostly from the swollen part of the columella, dark, purplish brown, anastomosing threads with cream coloured, granular wax deposits.
Spores : violet by transmitted light, warted, 6-7 μ in diameter.

This species is not a very common one in the locality. It differs from the existing species *Elaeomyxa miyazakiensis* (Emoto) Hagelst. in the colour of the sporangia and wax. But it is not yet certain whether this difference is a varietal difference or the described organism should be raised to a specific rank. The material is under study.

14. Soil fungi from the paddy fields of Orissa.

G. R. GHOSH and B. G. DUTTA, Cuttack.

Orissa is a state where paddy is the most important crop. Generally two crops are grown in this state, one is the main crop, sown in June and harvested in December, the other one is the 'Dalua' crop, which is sown in December and harvested in March or early April. An investigation into the fungus flora of the paddy fields has been undertaken. The present paper deals with the fungal flora of the 'Dalua' season only.

Out of the 77 fungi isolated from two paddy fields 38 are new additions to Indian soil fungi. Only the new reports are mentioned here :

Phycomycetes

Achlya deBaryana Humphrey, *Mucor fragilis* Bainier, *Podochytrium clavatum* Pfitzer, *Podochytrium lanceolatum* Sparrow, *Pythiopsis cymosa* de Bary.

Ascomycetes

Chaetomium homopilatum Omvik, *Chaetomium olivaceum* Cooke & Ellis, *Pseudoarachniotus* sp. (orange), *Pseudoarachniotus* sp. (red).

Deuteromycetes

Aspergillus clavatus Desm., *A. gracilis*)Bainier, *A. unguis* (Emile-Weil & Gaudin) Thom & Raper, *Botryotrichum* sp., *Botrytis bassiana* Balsamo, *Cladosporium herbarum* (Pers.) Link, *Curvularia pallescens* Boedijn, *Geotrichum candidum* Link, *Geotrichum flavo-brunneum* Miller, Giddens & Foster, *Gliocladium penicilloides* Corda, *Gonytrichum macrocladum* (Saccardo) Hughes, *Haplochalara* sp., *Hormiscium gelatinosum* Hedgcock, *Penicillium chermesinum* Biourge, *P. deleae* Zaleski, *P. purpurogenum* Fleroff-Stoll, *P. restricum* Gilman & Abbott, *Penicillum rugulosum* Thom, *P. sclerotiorum* van Beyma, *P. tardum* Thom, *P. varians* Smith, *P. velutinum* van Beyma, *P. warsmani* Zaleski, *Sepedonium chrysospermum* (Bull.) Fries, *Spicaria* (Thom) Gilman & Abbott, *Spicaria sylvatica* Oudemans, *Tetracoccosporium paxianum* Szabo, *Verticillum cellulosae* Daszewska, *Verticillium terrestre* (Link) *Lindau.*

15. Gymnoascaceae from India—3.

G. R. GHOSH, Cuttack, H. H. KUEHN U.S.A. and G. F. Orr, U.S.A.

The study of Gymnoascaceae has hitherto been neglected mainly due to the difficulty in isolation. By the isolation techniques developed by the authors, it has been possible to isolate a large number of Gymnoascomycetes (maximum by G. F. Orr). Among the Indian isolates three new reports are being presented here :

G5 is a species of *Pseudoarachniotus,* isolated from mouse dung. The fungus is bright golden yellow on the dung. On the basis of the colour and ascospore characters a new species is proposed. The ascospores are bright golden yellow, elliptical, to globose, in surface view, echinulate over the entire surface, 3·5-5 × 2·5-3 μ. *P. citrinus* has lemon yellow smooth spores.

G6 has bright reddish orange growth on the mouse dung. The hyphae are thick and septate which are suggestive of a loose peridium similar to previous isolates GI and GII. Hence the position is doubtful, but the characters are worthy of a new genus. The ascospores are 4-5 × 2·5 μ, elliptical, orange and with a medium raised band on the long axis.

G7 is a bright red fungus isolated from bat dung (Puri, Jagannath temple). On the peculiar adorations of the ascospores, which differ from *Pseudoarachniotus* *roseus*, a new species of *Pseudoarachniotus* is proposed. The ascospores are bright red, apiculate, elliptical, with two distinct bands on each axis which make them appear angular at four corners, 5-7 × 3·5 μ.

Other characters are discussed in details in the paper.

16. Gymnoascaceae from India--4 : two new species of *Pseudoarachniotus* from soil.

G. R. GHOSH and B. G. DUTTA, Cuttack.

1. *Pseudoarachniotus* sp. nov.

Growth on Sabouraud's P.S.A., cottony, at first white, then through cream, light yellow, golden yellow to deep orange in colour. The asci appear entangled in knots of hyphae. Discrete peridial hyphae lacking.

Asci : globose to pear shaped, 12-14 × 10-14 μ, 8 spored, wall evanescent when mature, orange in transmitted light.

Ascospores : yellowish when young, orange coloured with maturity, smooth, elliptical, with an equatorial band, 5-7 × 3·5 μ.

2. *Pseudoarachniotus* sp. nov.

The fungus described here does not fit in exactly in the genus and may have to be put in a new genus similar to G_1 & G_2.

Growth on Sabouraud's P.S.A. gregarious, discrete cleistothecia like balls are observed. Peridial hyphae)slightly thickened, hinge like. Racquet mycelium present.

Asci : globose, 10-12 μ in diameter, 8 spored.

Ascospores : red, distinctly spinulose, spines long, the spore appears roughned in low magnification, globose, 5-6 μ in diameter.

The above two species differ from the known species of *Pseudoarachniotus*, hence they are proposed to be new.

17. Influence of date of sowing on disease intensity and crop loss estimate of tumour Disease of coriander.

J. S. GUPTA, Agra.

The present study deals with the influence of time of sowing on disease intensity and crop-loss in *Coriandrum sativum* L. caused by *Protomyces macrosporus* Ung. Three sowing dates were tried extending over a period of one and half month (first sowing : 1st November ; second sowing : 25th November and third sowing : 20 December). Seeds of variety no. I.C. 3622 were sown in beds designed on random block method and results analysed statistically. Controls (plants) raised in uncontaminated soil) were maintained for each sowing. In the infected sets, soil was contaminated with suspension of chlamydospores obtained by crushing 2·5 gms. of completely diseased fruits in one gallon of water.

Total disease intensity and also disease intensity on stem, pedical and fruits separately were appraised in the plants grown in inftested beds. Height of plants, shoot dry weight at harvest, yield of fruits and number of seeds set in healthy and diseased plants were noted. Comparisons were also made between disease intensity and growth and yield characters.

Total disease intensity and that on stem, pedical and fruits separately varies with the date of sowing. Delay in sowing by about three weeks results in greater disease intensity (53%) compared to normal sown plants in the first week of November. Very delayed sowing (third sowing in the third week of December) causes a decrease in disease intensity (12·8%) but the plant growth is depressed considerably.

Under conditions of normal sowing (first sowing) the disease intensity on stem, pedicel or fruits is almost equally distributed. In the late sowings (second and third) a greater disease intensity on fruits in contrast to stem or pedicels was observed.

A direct relationship between disease intensity and loss in yield has been noticed, an increase in disease intensity results in increased loss in yield of fruits. Maximum loss of 67·7% with the maximum disease intensity of 53% was recorded in the second sowing (third week of November). Loss in yield is attributed to decrease in total number of fruits set, wastage of fruits due to hypertrophy or atrophy and also due to shrivelling of fruits produced by the infested plants.

18. Histopathological changes in fruits of coriander infected with *Protomyces Macrosporus* Ung.

J. S. GUPTA, Agra.

The changes in the fruits of *Coriandrum sativum* L inftcted with *Protomyces macrosporus* Ung. depend solely upon the time of infection of parasite and developmental stages of the fruits. In fully hypertrophied fruits the distinction into various layers of pericarp is lost. The epidermis elongates periclinally and the sclerencymatous layer so prominent in healthy fruits is lacking altogether. The xylem appears stretched. The dorsal vittate lie deeper in the tissues due to hypertrophy of the latter and lose their distinct shape. A great increase in size of the carpophore and stylopods is seen and the oil ducts are absent. The longitudinal splitting of the carpophore characteristic of a healthy ripe fruit does not take place in fully hypertrophied fruits as a result of which there is no separation into two mericarps.

The testa shrivels up while the endosperm and the embryo are lacking in hypertrophied fruits. In partly infected fruits when the infection reaches late the endosperm is formed but the size of its cells increases and granular matter in the cells appears. Less hypertrophied fruits show presence of shrivelled endosperm with poorly differentiated embryos.

Germination tests reveal that fully or relatively less hypetrophied mature fruit (seeds) do not germinate while partly infected seeds are viable.

Following Kuster's (1910, 1911 and 1925) concept of classification the galls formed by *Protomyces macrosporus* on fruits of *Coriandrum sativum* L. can easily be placed under the prosoplasmatic type of histioide galls. The observations are in line with the study of galls on *Crepis japonica* and *Lactuca debilis* infected by *Protomyces Inouyei* and *Protomyces Lactucae-debilis* (Akai, 1939) respectively.

19. Some foliicolous Deuteromycetes from Rewa (M.P.).

S. K. HASIJA, Rewa.

Some Fungi imperfecti causing leaf spots at Rewa have been described in this paper. It includes *Phyllosticta solani* Hasija, a new species, on *Solanum melongena* L. Pycnidia are 67·2–200 μ in diameter and conidia 12·8–22·4 $\times$ 4–6·4 μ, average 17·5 $\times$ 4·8 μ, *Colletotrichum capparidis* Hasija on *Capparis sepiaria* L. is another new species described. Acervuli are 46·2–99 μ in breadth, conidia hyaline, single celled, cylindrical and 13·2–16·5 $\times$ 3·3–6·6 μ, average 15·2 $\times$ 4·8 μ. The latin diagnoses of the new species are given. *Urochloa reptans* for *Colletotrichum graminicola* (Ces) Wilson and *Heteropogon contortus* Beauv. for *Curvularia lunata*

(Wakker) Boed. are new host record from India. *Helminthosporium capense* Thumen, a hyperparasite on *Meliola* sp. on the surface of *Citrus* leaves is a new record for the state.

20. Studies on apple seedling blight, *Sclerotium Rolfsii* Sacc., in Himachal Pradesh.

S. S. JAIN, Solan.

Seedling blight of apple has been observed in several nurseries in Himachal Pradesh. Isolations made from the diseased roots and collar readily yielded *Sclerotium rolfsii* Sacc., the pathogenicity of which was established. The disease causes heavy losses of nursery stock. Recently, losses upto 50% of young plants were observed in a nursery at Khalini, Kasumpti (Mahasu District). The disease is favoured by warm, humid weather, especially in ill-drained and shady places. At lower elevations (3500'—4000 a.s.l.), it appears during July to September(while at higher elevations (6000' a.s.l.), the infection is observed during April to June. The disease perpetuates by means of sclerotia. Change of site of the nursery to a plot not previously used for raising apple stocks was found to be a good preventive measure. Tests with soil disinfectants, such as Shell D-D Soil Fumigant (200 lb./acre), Cheshunt compound (2 oz./gal.), formalin (1 lb./3 gal.) mercuric chloride (1 lb./100 gal.) were conducted during 1958 to 60 at the Govt. nursery. Nagwain (3500' a.s.l.), where the disease assumed alarming proportions, to assess their comparative efficacy in controlling the disease, and also to study their effect on the germinability of apple seeds. The chemicals were applied to the soil @ ½ gal./sq.ft. about 3 weeks before planting. Cheshunt compound was further applied thrice during July-August. The results indicated that none of the chemicals had any adverse effect on the germinability of seeds, but rather had a beneficial effect on germination. The percent germination under different chemicals ranged from 8·9 to 11·1, compared with 6·3 in the untreated. Both formalin and Cheshunt compound, being equally effective, gave good control of the disease, the average mortality being 1·25%, followed by mercuric chloride with 2·50%. Shell D-D, though least effective, was notable superior to the control, the average mortality being 6·25% and 16·25%, respectively. Removal and destruction of diseased plants, avoidance of shade, water-logging and thick planting in, and frequent hoeing of nursery beds, rotation, and disinfection of soil with Cheshunt compound or formalin are recommended as measures for control.

21. On the possible role of Oxalic acid metabolite in the causation of wilts of guar (*Cyamopsis Psoralioides* DC.) and gram (*Cicer Arietinum* L.) by *Sclerotium Rolfsii* Sacc.

S. B. MATHUR and S. SINHA, Agra.

The role of toxins in causing wilts by certain soil fungi is now fully established. *Sclerotium rolfsii* is known to cause wilt of guar (*Cyamopsis psoralioides* DC.) and gram (*Cicer arietinum* L.). Cultures of this fungus produce oxalic acid which has been found to toxic to the hosts. Knowing the toxic nature of oxalic acid, several workers have suspected it to be responsible for the death of host plants. In the present investigation experiments were carried out to see the effect of synthetic and metabolite oxalic acid on seedlings of guar and gram on the causation of wilt.

Oxalic acid was synthesized by the fungus on Richard liquid medium and the filtrate showed the presence of oxalic acid which was detected by chromatography. Seedlings of guar and gram were grown first in three salt Shive solution and later on transferred to another series with the nutrient solution having the filtrate in varying proportions. Both guar and gram showed typical wilting symptoms. The toxic substance was thermo-stable, non-volatile and its effect decreased with dilution of the filterate. Another set of similar experiments was conducted in which synthetic oxalic acid was used instead of the filtrate and typical symptoms of the wilt were obtained in this case also.

From the present studies it is quite evident that oxalic acid is one of the causes for the wilting of guar and gram when infected with *Sclerotium rolfsii.*

22. Utilization of Sugars in Mixtures by Some Monoverticilliate Penicillia.

B. S. MEHROTRA and DINESH KUMAR, Allahabad.

The utilization of some sugars, when supplied in different mixtures, by *P. levitum* Raper and Fennell, *P. sclerotiorum* van Beyma, *P. citreo-viride* Biourge and *P. cyaneum* (B. and S.) Biourge was studied. These fungi, which are closely related morphologically showed different rate of assimilation of these sugars but they were generally akin in their preference towards the sugars when supplied in a mixture. Lactose and sorbose were the last to be utilized. Galactose, which is utilized slowly when supplied singly, is preferentially utilized from the mixtures by these fungi. Of the two pentoses, xylose and rhamnose, former was finished earlier, by these moulds except by *P. citreo-viride* which utilized rhamnose earlier than xylose. The results of the present study support the view that it is easy for fungi to secrete several enzymes in small quantities than one single enzyme in large quantity.

23. Occurrence of *Colletotrichum lindemuthianum* (Sacc. & Magn.) Briosi and Cav. on *Cassia fistula* L.

N. N. MOHANTY and B. C. BEHERA, Bhubaneswar.

A severe leaf spot disease of *Cassia fistula* L. caused by *Colletotrichum lindemuthianum* (Sacc. & Magn.) Briosi and Cav. = *Glomerella lindemuthianum* (Sacc. & Mag.) Shear was noticed in Khandagiri Hills near Bhubaneswar (Orissa) during October, 1960. The disease is characterised by the appearance of circular greyish-white spots with dark-brown narrow margins. The conidiophores of the fungus are hyaline, unbranched, unseptate, tapering towards tip and measure 3-4 × 17·5 – 35 μ. The conidia are hyaline, one celled, oblong to ovate with rounded ends, straight or slightly curved and measure 2-6·5 × 12-20 μ. Although the fungus has been recorded on *Phaseolus vulgaris* and on some other hosts from India, its occurrence on *Cassia fistula* L. appears to be a new record.

24. Ultraviolet induced mutations in *Rhizopus oryzeæ.*

P. NANDI, MISS K. BHATTACHARYA and A. K. MISHRA, Calcutta.

Work has been undertaken with *Rhizopus oryzeae* a Phycomycetous fungus producing lactic acid. It has a fast and spreading growth and colony counts are difficult to make, as all small colonies merge to form a bigger one. By trying different media and chemicals it has now been possible to get compact colonies of the fungus. The following media was developed—Glucose—40·0 gms ; KH_2PO_4—0·3 gms ; NH_4NO_3—1·2 gms ; $MgSO_4$—0·12 gms ; Ferric tartarate-0·003 gms ; NaCl—90·0 gms ; distilled water—1000 ml ; pH adjusted to 6·0. Percent survival of the spores of *R. oryzeae* with UV at an intensity of 100 ergs/mm^2/sec was 46·3%, 20·0%, 0·2% and 0·2% for 1,2,3 and 4 minutes of irradiation respectively. A number of lactic acid variants have been obtained, the detailed studies are in progress.

25. Colletotrichum on Chilli Fruits.

B. PADHI, Cuttack.

Chilli (*Capsicum annuum* L.) fruits have been found to be very severely affected by *Colletotrichum* in several fields of Cuttack in the rainy season of 1961. The symptoms are, more or less, like those of the "Ripe Rot", except that the acervuli develop gregariously and irregularly. The calyx cup and the stalk are, in quite a few cases, attacked and show the signs. Brown setae, upto 150 μ long, develop all over the erumpent acervuli, variable in size and shape. Colourless, entire and crescent shaped condia are 20μ to 25μ long. The fructification characters correspond to those of *C. capsici* Syd. which usually causes "Die Back" or "Anthracnose". Hence the fungus, under report, shows interesting linking characters and further studies are being undertaken.

26. The genus *Physoderma* Wallr. in Maharashtra.

S. D. PATIL, Poona.

Till 1949 the genus *Physoderma* Wallr. was believed to be represented in the old Bombay State by a single species. *Physoderma maydis* Miyabe occuring on the leaves of *Zea mays*. (Patel, Kamat and Bhide, 1949). In 1959, Thirumalachar et al recorded three more species from this State to which Thirumalachar and Pavgi (1956) added five new species mostly from Poona making a total of nine species for the Maharastra area. They are as follows :—

1. *Physoderma aeschynomenis* Thirumalachar and Whitehead on *Aeschynomene Indica* L.
2. *Physoderma bothriochloae* Thirum. & Pavgi on leaves of *Bothriochloa pertusa* (L.) A. Camus.
3 *Physoderma chrysopogonicola* Thirum. & Pavgi on leaves of *Chrysopogon* Sp.
4. *Physoderma cynodontis* Pavgi and Thirum. on leaves of *Cynodon dactylon* Pers.
5. *Physoderma dicksoni* Thirum. & Pavgi on leaves of *Iscilema laxum* Hack.
6. *Physoderma echinochloae* Thirum. & Whitehead on *Echinochloa crusgali* Beauv.
7. *Physoderma maydis* Miyabe on leaves of *Zeamays.* L.
8. *Physoderma narsimhanii* Thirum. & Pavgi on leaves of *Dactylotaenium aegypticum* Richt.
9. *Physoderma paspalidii* Thirum. & Pavgi on leaves of *Paspalidium geminatum* Stapf.

In addition to these nine species the author collected six more from near about Poona and Karad (District-Satara).

10. *Physoderma commelinae* Lingappa on the leaves, leaf sheaths and stem parts of *Commelina ferskalaei* Vahl.
11. *Physoderma corchori* Lingappa on stem, petioles and leaves of *Corcorus acutangularis* Lam.
12. *Physoderma dicanthicolum* Pavgi and Thirum. on leaves of *Dicanthium annulatum* (Forsk.) Stapf.
13. *Physoderma nelumbi* Misha and Thirum. on leaves of *Nelumbium speciosum* Wild.

14. *Physoderma setaricola* Pavgi & Thirum. on leaves of *Setaria glauca* Beauv.
15. *Physoderma schroeteri* Krieger on leaves of *Cyperus rotundus* Linn.

The genus thus seems to be represented by about 15 species now of these six constitute new records for the State. Two new host records are also given viz. *Commelinae ferskalaei,* and *Cyperus rotundus* for *Physoderma commelinae* and *Physoderma schroeteri* respectively.

27. Anthracnose of *Pithecolobium dulce* Linn.

R. Y. ROY and R. S. DWIVEDI, Varanasi.

This paper deals with a report of a member of *Colletotrichum* causing disease on *Pithecolobium dulce* Linn. ccollected from Allahabad city. The infection spots on leaves are circular to irregular varying from 2-15 cm. When the disease is severe, spots coalesce forming a broad patch and sometimes a shot-hole condition also prevails. Margin of the spot is somewhat raised, dark yellow, enclosing a dull grey centre. Acervuli sub-epidermal, dark brown, 30-90 μ, surrounded by light-brown to deep brown, two to three septate setae. Latter with bulbous base and with tapering apex, straight or slightly curved, $42\text{-}160 \times 3{\cdot}4\text{-}6$ μ and intermixed with simple, hyaline conidiophores. Conidia hyaline, sickle shaped with pointed ends, non-guttulate and vary from $16{\cdot}5\text{-}20 \times 2{\cdot}6\text{-}3{\cdot}3$ μ.

Roldan (1936) had reported a new species (*C. pithecolobii* sp. nov.) on the same host from the Philippine islands. The present fungus differs from Roldan's species in bearing (i) light brown to deep brown, two to three septate setae as against the black and non-septate setae of the Philippine's species, and (ii) smaller conidia. These differences are so obvious that it may be considered a new variety and tentatively it is being named *C. pithecolobii* var. *indicum* var. nov. Further work is in progress.

28. The genus *Caldariomyces* : A new report on *Cassia tora* Linn.

R. Y. ROY and R. S. DWIVEDI, Varanasi.

Cassia tora Linn. has been observed to be infected by a member of *Caldariomyces* in a locality near Durga-kund of Varanasi city. The pathogen was collected in September of 1960 and again in the same month of this year. The infection spots are black and are confined to the stipels on the rachis. Severity of the disease increases with the increase in dampness in the atmosphere and as a result the infection spots spread on the rachis. Conidiophores are synnemate-like in appearance, brownish-green, simple or branched, broad at the basal region and narrow towards the apex, sometimes proliferate into secondary ones, vary from $140\text{-}470 \times 10{\cdot}4\text{-}40$ μ, and bear sub-globose pycnidia at tips. Pycnidia are greenish-brown and rupture at maturity liberating globose to sub-globose conidia which very from $3{\cdot}5\text{-}7 \times 3{\cdot}5\text{-}4$ μ. This fungus differs from the other species described by Dwivedi (1960) in the profused proliferating and branching habits of conidiophores and bearing smaller conidia. Further work is in progress.

29. Studies on Sphaeropsidales. IV. Effect of temperature, carbon and sulphur requirements.

R. K. SAKSENA and DINESH KUMAR, Allahabad.

The effect of temperature and different carbon and nitrogen sources on the growth of four members of Sphaeropsidales, viz., *Botryodiplodia* sp., *B. theobromae, D. cajani* and *M. phaseoli* was noted.

While the minimum temperature was between 10°C and 15°C the optimum temperature was 30°C. The upper limit of temperature range was 40°C for *Botryodiplodia* sp. and *B. theobromae* and 45°C and 50°C for *Macrophomina phaseoli* and *Diplodia cajani*. The rate of growth of these organisms increased with the rise of temperature till 30°C. None of the present fungi showed a constant rate of growth under constant conditions.

Amongst the pentoses (carbon sources) arabinose, was preferentially utilized over xylose. On the other hand, of the hexoses dextrose was good source for *Botryodiplodia theobromae* and *Macrophomina phaseoli* while mannose was good for *Botryodiplodia* sp. and *Macrophomina phaseoli*. For the rest of the organisms dextrose was moderate and mannose was a poor source of carbon. The disaccharides —sucrose and maltose—were good sources for most of the organisms studied. Of the two polysaccharides dextrin was good for all the present fungi while starch varied from good to poor for different fungi investigated. Sorbitol was good for the growth of majority of the fungi, but mannitol and glycerol were poor sources for most of them. Except for *Diplodia cajani* which grew well on tartaric acid, none of the present fungi showed any liking either for malic or tartaric acid.

While studying the sulphur requirements it was found that out of the inorganic sources potassium sulphate and sodium hyposulphite were good sources for all the fungi except *Botryodiplodia* sp., but sodium sulphite was good only for *Diplodia cajani*. Sodium thiosulphate supported good growth of majority of present organisms. However, sodium bisulphite proved to be good for *Diplodia cajani* and *Macrophomina phaseoli* only. Amongst the organic sulphur compounds cystine did not support any growth of these fungi, thiourea was a poor source for *Botryodiplodia* sp. and *Diplodia cajani* and methionine was good for all of them.

30. Studies on the Periodicity of occurrence of certain Fungi from the Soils of Gauhati—Assam.

G. SATYANARAYANA and H. K. BARUAH, Gauhati.

During the course of a study on the evaluation of soil fungi from the soils of Gauhati, a very interesting phenomena was observed in the mode of occurrence of Aspergilli, on the basis of soil dilution technique. Four species of Aspergillus constituted nearly 40 per cent of the total soil fungal population. However, strangely the aspergillus population was not constantly available in the soil. During the cold months of December, January and February the aspergilli were totally absent on the dilution plates even when 1/100 dilution was used. In July, June and May the aspergilli were the maximum in occurrence. Soils when directly plated on the nutrient medium as suggested by Warcup yielded aspergilli indicating that the aspergilli survive the cold season in the mycelial stage. The bio-chemical activities of the soil fungi will be published in a separate paper as the work is still in progress.

31. Effect of Carbon and Nitrogen sources on the production of an antibiotic by *Streptomyces* sp. active against a non-sporulating fungus pathogen.

N. P. SINGH and K. C. BASU CHAUDHURY, Agra.

Singh and Sinha (1962) reported antagonistic affect of a *Streptomyces* sp. on a non-sporulating fungus parasite (Isolate No. Z) causing decay of fruits of *Hibiscus esculentus* Linn. In this paper the effect of different carbon sources (xylose, arabinose, glucose, fructose and lactose) and nitrogen sources (potassium nitrate, ammonium nitrate, alanine, acetamide and urea) on the production of the antibiotic substance by the *Streptomyces* sp. has been presented.

Among the different carbon sources tested, all were utilized but to varying degrees. Fructose was the best source with an inhibition zone of 4 mm. followed by, in the descending order, glucose (2·6 mm.), arabinose (2·6 mm.), xylose (2·3 mm.) and lactose (2 mm.). Further, an experiment was conducted to see the effect of varying concentrations of fructose viz. 2%, 3·15%, 4%, 6%, 8% and 10% and it was found that the production of the active substance decreased as the sugar concentration was increased from 2% to 10%.

Like carbon sources, the *Streptomyces* sp. utilized the various nitrogen sources giving different results. The inhibition zones formed by different sources are: ammonium nitrate 4·9 mm., potassium nitrate 2·6 mm., alanine 4·3 mm., acetamide 3·5 mm· and urea 2·0 mm.

32. Microorganisms of some Vegetable Surfaces and Tissues and their antagonism.

N. P. SINGH and S. SINHA, Agra.

Simard et al (1958) showed antagonism between some microorganisms isolated from the surface of deal apple leaves and the apple scab fungus, *Venturia inaequalis*. Microorganisms of the surface thus seem to play an important role in the disease relationships of plants. The present investigation of this kind was, therefore, extended to the surface and tissue isolates of some vegetables viz. brinjal (*Solanum melongena*), bottle-gourd (*Lagenaria vulgaris*) and lady's finger (*Hibiscus esculentus*). Among the surface isolates were: 1. *Zygorrhynchus* sp., 2. *Aspergillus* sp. (I), 3. *Aspergillus niger,* 4. *Aspergillus fumigatus,* 5. *Aspergillus tamarii,* 6. *Aspergillus* sp. (II), 7. *Aspergillus sydowi,* 8. *Fusarium* sp., 9. *Monilia* sp., 10. *Cladosporium* sp., 11. *Curvularia* sp., 12. Unsporulating fungus (X), 13. Unsporulating fungus (Y), 14. *Streptomyces* sp., 15. B_1 (Coccoid, Gram –), 16. B_2 (Bacillus, Gram –), 17. B_3 (Coccoid, gram –), 18. B_4 (Coccoid, gram +), 19. B_5 (Spirillum, gram –), 20. B_6 (Coccoid, gram +), 21. B_7 (Coccoid, gram +), 22. B_8 (Bacillus, gram –), 23. B_9 (Coccoid, gram –), 24. B_{10} (Coccoid, gram +). Some of these were obtained exclusively from one type of vegetable, while others were common to two and still a few only isolated from all the three. The isolates causing decay of the vegetables were: two species of *Fusarium* and one non-sporulating fungus. Screening for antagonism among these organisms revealed four positive cases. Further study on the active principles involved in the antagonism forms a piece of separate communication.

33. Spore discharge in *Ganoderma*.

T. SREERAMULU, Waltair.

Although the principles involved in the basidiospore discharge have been described in some detail in recent years, very little is known about the effects of external conditions on basidiospore discharge. No quantitative data are available on the spore discharge in Hymenomycetes. For *Ganoderma*, the heart-rot fungus with hardy perennial bracket-like fruit bodies, it has been shown that spore discharge starts in May and continues until September each year and during these months spore output goes on more or less continuously on a large scale. To provide quantitative data on the rate of spore discharge during these months and to know how external factors like temperature, rain, relative humidity and light determine the day-to-day variations in the rate of spore discharge in *Ganoderma*, continuous quantitative sampling of air near the fruit bodies of this fungus was conducted in June-July in two consecutive years. Hirst's automatic volumetric spore trap with its orifice kept at a height of 35 inches above the ground level was employed for air sampling, which was located within 100 yards from the trunk of a tree with three large fruit bodies of *Ganoderma applanatum* growing at about this height. From the data thus collected the diurnal periodicity of spore discharge and how the changes in the spore output are affected by the changes occurring in one or many external factors on different days have been examined. Some of these observations are described in this paper.

On dry days with normal changes in the weather conditions spores of *Ganoderma* are practically absent during the daytime from 08·00 to 16·00 hrs. They begin to appear in small numbers from 18·00 hrs. onwards and within four hours (by 22·00 hrs.) considerable number of these appear in the air. Highest concentrations are encountered during the middle of the night (from 22·00 till 04·00 hrs.) with the daily peak occurring between midnight and 02·00 hrs. These changes recurring regularly on many days suggest the existence of a nocturnal spore discharge mechanism in this fungus. Among the different external factors examined, humidity and rain seem to determine, to a certain extent, the number of spores discharged during the peak hours on any day.

The results obtained under natural conditions are described and discussed and the need for undertaking experimental work under controlled conditions with a view to assessing the role of different factors in determining the diurnal cycle of spore discharge in *Ganoderma* has been pointed out.

34. Leaf-spot of *Eriobotrya Japonica* Lindl.

K. S. THIND and C. L. MADAHAR, Chandigarh.

This paper deals with a new species of *Monochaetia* causing the leaf-spot disease of *Eriobotrya japonica*. It was observed during January to March, 1960, in orchards around Amritsar. The infected leaves are characterized by the presence of isolated, small, round, necrotic areas of brownish to straw colour, up to 7 mm. in length. In severely infected leaves a number of such spots coalesce. Black, dot-like bodies—the acervuli appear on the necrotic areas.

Acervuli : 188-625 × 125-500 μ, distinct, isolated, from 2-3 to a large number on a necrotic area, discoid or cushion-shaped, subcuticular, but later on the cuticle and epidermis cracks above them. Conidiophores hyaline, short, stout, erect, each bearing one spore at the apex. Conidia 20-28 × 7-9 μ, elliptical, 5-6 cells in each spore, 6 being the commonest number, middle four cells of dark brown colour, each being barrel-shaped; both the end cells pointed, hyaline, apical end cell always prolonged distally into a fine, slender, true appendage, sometimes the lower end cell (but only in a spore which is detached from the conidiophore) also projects into an appendage. The latter is the false appendage, being only the broken and stretched left over part of the conidiophore, so the number of appendages is 1-2; appendages 0·7-3 μ long, hyaline, short. Many long, thin, filiform, hyaline paraphyses-like structures are given out from the base of the acervulus, with intermixed conidiophores.

Fungus is easily culturable. It forms a brown pigment and abundant acervuli on P.D.A. Acervuli are reduced in size in culture and occur individually or in groups. Conidiophores and conidia have almost the same size and structure in culture as on the host.

No species of *Monochaetia* is recorded so far on *Eriobotrya japonica*. It does not fit in any known species and is characterized by the profusely developed "paraphyses" in the acervulus. Conidiophores are much less in number and much smaller in size as compared with these. The conidiophores, however, are wider, straight to bent but not flexuous. The "paraphyses", however, are usually flexuous.

Bryophytes

35. A new report on the occurrence of the moss, *Eurynchium mulleri* (Bry. Jav.) Bartr. in Nilgiri Hills (South India).

C. SRINIVASAN, Annamalainagar.

Ninety five different species of mosses were collected for detailed study from the hills of Kodaikanal and the Nilgiris of South India. Advanced studies of the South Indian mosses in various aspects are progressing well in this laboratory for the past five years. This)plant in question was identified as belonging to *Brachytheciaceae*. When they were sent to a few international authorities for specific determination Professor E. B. Bartram of U.S.A. assures that it is *Eurhynchium mulleri* (Bry. Jav.) Bartr. and adds that it has not been recorded from India before. Fleischer called this plant as *Platyhypnidium mulleri* and included it under *Amblystegiaceae* and Brotherus followed it and referred this species to occur in Java, Sumatra and Luzon.

Therefore, this plant is now reported for the first time to occur in the hills of Kodaikanal in the forest of Priests' Walk at an altitude of about 2300 metres. A brief description of the plant follows :—

This darkish green pleurocarpous moss 3 to 4 c.m. tall, grows creeping on the moist shaded rocks where water is perennially oozing out. It branches profusely and they are erect. The leaves 460 to 484 μ long and 400 to 418 μ broad, are broadly ovate, apex obtuse, upper margin serrulate, midrib extending only up to the lower half and thining out upwards, laminar cells elongated rhombic to linear; seta red elongated, capsule inclined ovoid; peristome 130 to 132 μ × 22 μ at base, operculum arched conical ending in a long stout oblique beak. The axis has a hypodermal rind of thick walled cells. The central strand is absent but it is composed of thin walled parenchymatous cells as is characteristic of the pleurocarpous mosses.

Pteridophytes

36. Studies on the morphology and affinity of the family Parkeriaceae. 1. Morphological observations in *Ceratopteris thalictroides* (L.) Ad. Brongn.

NIRANJAN PAL, Calcutta.

The plants grow free-floating, submerged or on land in the fields, ditches, swamps and wet places and the habit and habitat are largely influenced by these conditions of growth. The size and shape of the successive sterile leaves in a plant are gradually graded leading to an uniform type of highly pinnatisect fertile leaves. Scales occur on the rhizome and young leaf. The latter also bear small glandular hairs.

The rhizome is juvenile plants is protostelic which is gradually transformed into a highly dissected dictyostele with medullary strands in the later-formed regions. The larger peripheral meristeles are arranged in an irregular ring which are intimately related to the irregularly distributed medullary strands. The medullary meristeles of the rhizome have little correlation with those of the stipe. The meristeles are hadrocentric but often assume 'bicollateral' due to profuse anastomosis between the larger meristeles or 'collatral' when they are narrow as in veins. Endodermis and pericycle in rhizome and leaf arise from a common layer of mother cells and are cortical in origin. The endodermis is of the 'primary type'. A feeble cortical mechanical tissue develops round each meristele. The epidermis of the leaf is chlorophyllous. Stomata are present on both surfaces of the sterile leaf, on the upper surface of fertile segments and also on the stipe. Mesophyll remains undifferentiated. The primary root originates from a sub-epidermal cell (cortical) of the leaf-base but the secondary root is endodermal in origin. The segmentation, histogenesis and structure of the mature root (though more or less in conformity with other leptosporangiate ferns) are in contradiction with the descriptions provided in the text-books. The endodermis and pericycle have separate origin in root. The root stele is diarch and appear as 'bicollateral' in form.

37. The Gametophyte of *Microsorum Punctatum* (L.) Copel.

NIRANJAN PAL, Calcutta.

Germ tube comes along the linear scar of the spore coat a week after sowing in sterilized soil mixture. First rhizoid appears belated. The germ tube undergoes repeated transvrse divisions and the first vertical wall appears in the terminal or penultimate cell when the filament is 5-9 cells long. By repeated vertical divisions the filament is gradually flattened and a wedge-shaped terminal cell may become differentiated early or at a later period of development. This cell, however, never behaves like a typical apical cell and the diffused type of growth of the gametophyte later becomes localized when an apical marginal meristem is organized. The mature prothallus is cordate and elongated but sometimes nearly ribbon-shaped. Irregularities like unusual elongation of the filament or branching at an early or later period of growth are not infrequent. The prothallus remains one-cell thick except the midrib region. The gametophytes are protandrous, antheridia appearing about one month after germination. Development, structure and position of the sex organs are normal but sometimes some antheridia may be marginal. Rhizoids are brown and they occur in the lower half of the thallus. Unicellular marginal hairs grow sparsely and only at a very late stage of development of the gametophyte. Hairs also occur superficially and these are multicellular, glandular and often branched. Cell-walls of the gametophyte remain thin.

38. Enumeration and distribution of Fern Allies in Eastern India.

G. PANIGRAHI and S. CHOWDHURY, Shillong.

Of the 5 genera and 72 species of non-filicean Pteridophytes in India, this paper presents an enumeration of 45 species of fern. allies belonging to 5 genera (viz. *Psilotum* 1 sp., *Lycopodium* 11 spp., *Selaginella* 30 spp., *Isoetes* 1 sp., *Equisetum* 2 spp.) collected by the Eastern Circle of the Botanical Survey of India from different parts of Eastern India between 1956-1960. Important notes on the habit and habitat of each species, collectors' numbers and localities of occurrence and their relative abundance in the area, are appended to each species. It includes nine species, viz. *Psilotum nudum* (Linn.) Beauv (17522 Geling), *Selaginella intermedia* (Blume) Spring (19419 *Kimin*), *S. pennata* (Don) Spring (17770 Ninguing), *S. pallida* Hook. et Grev.) Spring (19482 Kimin), *S. pronixora* (Lamk.) Baker (4090 Jowai), *S. tenera* (Hook. et Grev.) Spring (3945 Shillong), *S. wallichii* (Hook. et Grev.) Spring (6032 Sissini), *S. wightii* Hieron (7981 Towang), and *Isoetes coromandelina* Linn. (20553 Padmapur) as new records for Eastern India ; eight species, viz. *Selaginella amblyphyla* Alston (3558 Cherrapunji), *S. argentea* (Wall.) Spring (2695 Cherrapunji), *S. atrovirides* (Wall.) Shing (14446 Khela), *S. brachystachya* (Hook. et Grev.) Spring (18981 Digboi), *S. calostachya* (Hook. et Grev.) Alston (14981 Niusa), *S. implexa* (8081 Rahung), *S. peltata* Presl (15310 Baha) and *S. warburghii* Hieron (6950 Bomdila), as new records for India.

The fern allies, though prolific in the number of species in tropical and subtropical forest types, are very rare in temperate altitudes and are completely absent from subalpine and alpine situations. It is significent that *Selaginella wightii* grows on dry bare rock and together with *S. proniflora*, *S. repanda* and *S. subdiaphana* etc., are more or less xerophytic in nature and rigid and grey in texture. In contrast *S. pentagona*, a native of tropical evergreen forests, grows upto 3 m. and trails through bushes.

39. Pteridaceae in Eastern India.

G. RAGHAVA KUMARI and G. PANIGRAHI, Shillong.

Pteridaceae (Copeland 1947) with 26 genera and 82 species in India is one of the three largest families of Pteridophytes next in abundance to Aspidiaceae and Polypodiaceae in Eastern India. This paper enumerates 18 genera and 55 species collected from different parts of Orissa, Bihar, Assam and N.E.F.A. by the Eastern Circle of the Botanical Survey of India from 1956-1960 with correct names (Panigrahi 1960), furnishes important notes on the habit and habitat of each species with localities of occurrence and abundance and presents in a tabular from the distribution of each species in different types of forests met with in the area (Rao and Panigrahi 1961).

An analysis of the ecogeographical distribution of the species reveals that while 33 species grow luxuriantly in the tropical evergreen and semievergreen forests and 22 species in moist/dry deciduous forests, as many as 42 species flourish in the subtropical)mixed and pine forests either as sun-loving or shade-loving terrestrials. In contrast, only 9 species are found in the tropical riverine forests and 10 species in the subtropical grass lands while another 10 species ascend higher upto temperate altitudes only.

It appears that genera such as *Cibotium, Microlepia, Lindseca, Sphenomeris, Histiopteris, Cheilanthes, Pityrogramma,* are altogether)absent from temperate altitudes, while *Dennstaedtia appendiculata* and *Anogramma microphylla* are the only two species restricted to temperate situations only. On the otherhand, *Dennstaedtia scabra, Pteris ensiformis, Pteridium aquilinum, coniogramme fraxinea, Aleuritopteris anceps, Onychium japonicum* etc. are widespread species from tropical to temperate forests. But *Microlepia platyphylla, Monachosorum subdigitatum, Hypolepis alpina, Pteris longipes, Cheilanthes hufa* etc. are few of the species restricted to subtropical forests only.

40. Genus *Asplenium* in Eastern India.

G. V. SUBBA RAO and G. PANIGRAHI, Shillong.

Genus *Asplenium* with its 700 species in the world flora is represented in India by 44 species and 13 varieties. This paper presents an enumeration of 29 species of *Asplenium* collected from Orissa, Bihar, Assam and NEFA by the Eastern Circle, Botanical Survey of India between 1956-1960, using correct names (Panigrahi 1960), together with citation of literature and furnishes important notes on the habit and habitat of each species with exact localities of occurrence and abundance in the area. It classifies, in a tabular form, the altitudinal limits to which a species asceends and the types of forests in which it flourishes well either as an epiphytic or as terrestrial species, growing on moss-covered tree trunks and branches, in crevices of rocks or in leafy-littered forest floor.

The enumeration includes *A. borneense* (7440 Kimin), *A. paradoxum* (23923, Tumbing, Siang F.D.), *A. perakense* (7539, Chakoo), *A. scortechinii* (7613, Koppu, Siang F.D.), *A. spathulinum* (7673, Rupa), *A. subnormale* (7653, Rupa) (cf. Panigrahi 1960) as new records of species for India.

It appears that the genus *Asplenium* is prolific in number of species in the tropical and sub-tropical evergreen/semi-evergreen forests. Although 9 species ascend higher and occur in temperate altitudes the genus is completely absent from subalpine and alpine situations. *Asplenium alternans*, restricted to temperate altitudes, contrasts with *A. perakense* which occurs from the tropics of Orissa to temperate regions of NEFA. It is interesting to observe that *A. borneense*, *A. finiaysonianum*, *A. glaucophyllum*, *A. nidus*, *A. scortechinii* and *A. spathulinum* growing luxuriantly in the tropical and sub-tropical forests, are absent from the temperate ones, whereas *A. ensiforme*, *A. griffithianum*, *A. tenuifolium*, *A. unilaterale* which thrive well in sub-tropical and temperate forests, seem to be absent from the tropics.

41. *Selaginellas* from the North-East Himalayan Region.

V. THAKUR, Patna.

During a botanical excursion made in October-November, 1958, covering Darjeeling, Kalimpong and some)part of Sikkim, a fairly good number of *Selaginellas* were collected along with other plants They are given as below :

Name	Locality	Ref. No.
1. *Selaginella adunca*, A Br.	Darjeeling	VT/110
2. *S. biformis*, A. Br.	,,	VT/112
3. *S. barbata* (Kaulf.) Spring. syn. *S. repanda* (Desf.) Spring., syn. *Lycopodium barbatum*, Kaulf.	Gangtok	VT/$\frac{43}{8}$/1958
4. *S. ciliaris* (Retz.) Spring., syn. *Lycopodium ciliare*, Retz.	Kalimpong	VT/$\frac{33}{8}$/1958.
5. *S. delicatula*, Alston.	Darjeeling and Kalimpong	VT/111
6. *S. halferi*, Wart.	Gangtok	VT/114
7. *S. involvens* (Sw.) Spring.	,,	VT/108 & VT/117
8. *S. longipila*, Baker.	Darjeeling	VT/116
9. *S. pentagona*, Spring.	Gangtok	VT/42/1958
10. *S. proniflora*, Baker.	Kalimpong	VT/$\frac{33}{c}$/1958
11. *S. plumosa*, Baker.	Gangtok	VT/113
12. *S. semicordata* (Wall.) Spring.	Gangtok and Darjeeling	VT/109 & VT/115

Many species are common; while others are confined to particular locality. *S delicatula* collected from Kalimpong was different from one collected at Darjeeling. A herbarium specimen of each of these species has been deposited in the Central National Herbarium, Calcutta.

42. Studies on Indian Hymenophyllaceae. Pt. II. Contributions to our knowledge of *Hymenophyllum simonsianum* Hooker.

MISS USHA SHARMA, Lucknow.

The morphological and anatomical studies of a north Indian Hymenophyllacea, collected from Khasi and Jayantia hills, have been described in this paper. This fern is characterised by the presence of roots, which are diarch or triarch. The jet black rhizome is covered all over by one to four celled hairs which are also present all over the leaf on the petiole. The stele is concentric protostele as in *Crepidomanes latealatum.* The leaf trace is concentric at the base and becomes collateral higher up.

The indusium is deeply cleft; the valves being serrate, and the receptacle is elongated but never exserted. The sorus is a simultaneous one.

The sporangia, with oblique and complete annulus numbering eighteen cells, measure 321·0$\mu \times$294·4μ. The tetrahedral spores number ninety four to hundred fourteen and measure 46·6$\mu \times$43·7μ.

43. Studies on Indian Hymenophyllaceae. Pt. III. Contributions to our knowledge of *Meringium edentulum* (v.d.B.) Copel.

Miss USHA SHARMA, Lucknow.

In this paper are described the morphology and anatomy of a Hymenophyllaceous form *Meringium edentulum* collected from Khasi and Jayantia hills of Assam.

The roots are present and are usually diarch or triarch. The thin, jet black rhizome is covered by one to three celled hairs which are very scanty and are absent from petiole. The stele is a mesarch concentric protostele. The pinnately lobed leaf has a stele similar to that of rhizome at the very base but becomes collateral later on.

44. Studies on Indian Hymenophyllaceae. Pt. IV. Contributions to our knowledge of *Mecodiumbadium* Copel.

Miss USHA SHARMA, Lucknow.

The paper deals with the morphology, anatomy, sporangial development and certain stages of cytology of *Mecodium badium,* collected from Khasi and Jayantia hills.

The roots have typical diarch or triarch stele. The rhizome stele is characterised by a double metaxylem band with Mesarch (?) protoxylem.

The pinnately lobed leaf is winged except at the very base. The wings are crisp and are 2·0–2·5 mm wide. The stele in the leaf which is concentric at the very base and collateral a little higher up is shaped, the protoxylem occupying the incurved ends.

The sori number two to twelve on each pinna. The indusium is usually circular and deeply cleft; the clefts approaching the base. The short receptacle is always included. The sorus is almost simultaneous in development as in *Hymenophyllum simonsianum.*

The sporangium measure 488·8$\mu \times$394·8μ and is initiated by a single cell. The annulus is made up of twenty six to twenty seven cells. The spores are circular, tetrahedral and measure 53·48μ.

45. Studies on Indian Hymenophyllaceae. Pt. V. Some developmental stages of the gametophyte of *Mecodium badium* Copel. found within the sporangium.

Miss USHA SHARMA, Lucknow.

Not much is known about the germination of spores inside the sporangium. Even if known the gametophytes have not been observed beyond the three celled stage. In the material of *M. badium* examined, a number of sporangia showed stages of germination upto ten celled stage, which is rather unusual. All these different stages have been described and figured.

46. Studies on Indian Hymenophyllaceae. Pt. VI. Contributions to our knowledge of *Crepidomanes bipunctatum* (Poiret) Copel.

Miss USHA SHARMA, Lucknow.

In the present paper, observations on morphology, anatomy sporangial development and cytogenesis of *C. bipunctatum* have been recorded.

As also in *Crepidomanes latealatum*, the roots are absent in this species also. The thick, filiform, and black rhizome is covered all over by unicellular hairs. The stele is concentric. The pinnately lobed leaf is characterised by the presence of submarginal false veinlets unrelated to veins.

The sori are numerous and are present on both the sides of the pinna. The obconic indusium is united below and free above with entire valves. The receptacle is long; included when young but becomes excluded later on. The source is usually gradate and basipetal but certain sori show the old sporangia with younger ones above as well as below. This indicates that the sorus may not always be a strictly gradate one as mentioned by earlier workers. It may on the other hand be sometimes mixed and simultaneous also atleast in some species of the family.

The sporangia, measuring $263\mu \times 235\mu$ have an oblique annulus of 19 to 20 cells, opening by a transverse slit marked by a couple of cells. The sporangium is initiated from a single cell as in the other genera studied so far by the author.

The spore, bearing triradiate mark at its proximal end, has got a large nucleus on one side and measures $48\mu \times 40\mu$.

Gymnosperms

47. Cytology of *Cycas*.

B. V. SHETTY and K. SUBRAMANYAM, Calcutta.

The diploid chromosome numbers in *Cycas beddomei* Dyer, *C. circinnalis* L., and *C. revoluta* Thunb. have been determined to be 22 of which the chromosome number for *C. beddomei* is reported here for the first time. The karyotypes are similar in all the species investigated, except that a pair of heteromorphic chromosomes were observed in *C. circinnalis* and *C. revoluta*. These are presumed to be sex chromosomes, the males being heterogametic and the females homogametic.

Palaeobotany

48. The history of the vegetation of the lower Gangetic plain.

NITYANANDA MALLIK, SALIL KUMAR CHAUDHURI and J. SEN, Calcutta.

The pollen flora of the upper peat horizon below Calcutta has been investigated as part of a programme for studying the history of the vegetation of the lower Gangetic plain. The results of analysis of peat from sections exposed during digging operation near Birati (10 miles N.E. of Calcutta) are described and discussed in this paper.

The peat horizon consists of a lower highly humified layer, a middle moderately humified layer and an upper diffuse layer of peat and clay. Each of these layers is separated by clay. The pollen diagram is revealing. Succession of forests in its gross features revals the gradual elimination of arboreous plants, grasses, sedges and ferns, which are present everywhere, specially the former, becoming more dominant. The arboreous forms, e.g., *Phoenix paludosa, Bruguiera parviflora, B. gymnorhiza, Heritiera* sp., etc., and some identificable harbaceous forms are all eliments of a swamp flora, which once thrived in and around the present Calcutta region. This flora has since migrated further southwards and formed (perhaps together with others) the present vegetation of the Sunderbans.

More samples are now being collected and analysed for confirming these preliminary observations. The morphology of spores and pollen of the living vascular plants of the lower Gangetic plain is being studied for making further identification of the microflora in the peat.

The megascopic flora has not been considered in this paper, specially because it is not inconsistent with microflora data.

49. Distribution of plant fossils in the Raniganj Coalfield, Bengal.

SALIL KUMAR CHAUDHURI, NITYANANDA MALLIK and J. SEN, Calcutta.

The paper embodies some results of floristic studies mainly of the Western part of the Raniganj Coalfield. This is part of a more comprehensive work, now in progress, to study the flora of whole of the Raniganj Coalfield.

About 12 species of *Glossopteris*, and 1 species each of *Taeniopteris, Palaeovittaria, Vertebraria, Schizoneura* and *Phyllotheca*, and a number of doubtful specimens and seeds, occur in the successive coal seams of the area under investigations. The relative abundance of these species in different seams, as also in different parts of a single seam, has been worked out. As case of apparent change in the vertical distribution of the flora has been discussed with reference to the known stratigraphy of the area. Megaspores are now being studied as additional tools.

50. Pollen-analytical investigations of the Lower Karewas.

VISHNU-MITTRE, GURDIP SINGH and K. M. S. SAXENA, Lucknow.

From the pollen diagrams recently constructed from the L. Karewa deposits exposed at Sedau, Laredura, Nichahom, Botapathri and Raithan along the North Eastern slope of the Pir Panjal in the SW of Kashmir Valley, the paper describes the vegetational history and the climatic alterations during the early Pleistocene in this region.,The various phases of vegetational development comprise the oak woods, the open pine-mixed woods, the oak-mixed woods, the *Picea*-oak woods and the *Juglans*-elm woods.

During this period when the Lower Karewas were laid, the climate continued to be temperate with the sequence from wet-dry-moist.

The vegetational sequence and the climatic changes are discussed in relation to stratigraphy and finally in the light of these the age of the deposits is determined.

Angiosperms

51. *Morphology of Malpighia Glabra* Linn.

BAHADUR SINGH, Lucknow.

Embryology of *Malpighia glabra*, a rich source of vitamin C, has been worked out to ascertain the possibility of its hydridization as some other Malpighiaceae show only nucellar embryos and no fertilization.

Microsporogenesis and development of male gametophyte follow the usual course. The tetra-sporic 16 nucleate embryo sac of Penaea type develop sometimes with 15, 14 or even nuclei only.

Pollen tubes are seen in the micropyle. Many embryo sacs degenerate completely. Only polar nuclei of some others survive and their fusion product divides to from endosperm which nurishes nucellar embryos. When egg also survives, only zygotic embryo develops.

The seed coat is formed of both epidermis of the outer integument. Only the inner wall, as well as the radial ones of the inner epidermis, of the inner integument persist separated by an air sac from the testa whose mature cells become lignified and the outer layer develops reticulate thickenings. Only one or two layers of endosperm persist in a seed. The embryo is conduplicate, dicotyledonous and the cotyledons are leafy.

52. The wood anatomy of Meliaceae (Sub-family Cedreloideae).

C. BHASKARARAMA SASTRY, Waltair.

An extensive collection of the wood samples of the different genera belonging to the Meliaceae, was made from different parts of the world. The present communication represents the observations made on the anatomical features of the woods of *Cedrela toona* Roxb., *Cedrela odorata* Linn., *Cedrela Gssilis* Vell., *Cedrela microcarpa.*, *Toona sureni* Merr., *Toona calantas* Merr. & Rolfe., *Chloroxylon swietenia* Dc., and *Ptacroxylon obliquum* E. Mey of the sub-family Cedreloideae.

The presence of ring porous wood with fairly distinct growth rings, solitary vessels with gummy deposits, perforation plate exclusively simple, intervessel pitting predominantly alternate and medium sized with occasional coalscence of apertures, fibres partly septate and with bordered pits, heterogeneous rays with crystalliferous cells, scanty paratracheal parenchyma along with initial and apotracheal diffuse parenchyma, in strands, with crystals in some of their cells and vertical traumatic gum cavities are characters common to both *Cedrela* and *Toona*. Although *Cedrela* and *Toona* enjoyed separate generic status in the hands of some morphologists, on grounds of wood anatomy *Toona* can be considered as a species of *Cedrela.*

The present study does not lend support for transferring *Cedrela* to Swietenioideae as proposed by Kribs (1930). *Chloroxylon* and *Ptacroxylon* differ from other genera of the Meliaceae in possessing extremely small vessels, aggregate pores, scanty paratracheal parenchyma, non-septate libriform fibres and rays which are homogeneous and uniseriate in *Ptacroxylon* and heterogeneous and storied in *Chloroxylon.*

Work on other members of the sub-families, Swietenioideae and Melioideae is in progress.

53. Studies on the structural morphology of pollen grain in the genus *Crotalaria*

P. K. BISWAS and R. M. DATTA, Calcutta.

Pollen grains in *C. juncea, C. usaramoensis* and *C. verrucosa* are 3-colpate. Sexine is thicker than nexine, its surface undulating reticulate with L-O pattern.

Comparative measurements (length at polar axis/breadth at polar axis) and other characters show that *C. juncea* is intermediate between the two other species. Evolution in this genus is of divaricate type, though in one direction as shown by main morphological characters.

54. The structure and development of ovule and seed of Passiflora foetida Linn.

DALBIR SINGH, Jodhpur.

The paper deals with the investigation of the structure and development of seed of *Passiflora foetida* Linn. Its ovary is tricarpellary, syncarpous and unilocular with parietal placentation. Ovules are anatropous, crassinucellate and bitegmic. Micropyle is formed by both the integuments and it obliquely faces the ovary wall. The vascular supply of the ovule after entering the funiculus travels the raphe and terminates at the chalaza, where it branches forming an inverted umbrella-like structure.

Pollen tube is porogamous and persistent. Occasionally it convolutes inside the embryo sac. Endosperm develops normally in embryo sacs with convoluted persistent pollen tube.

Endosperm development is free nuclear. Enucleate cytoplasmic nodules are observed on the micropylar as well as the chalazal side of the free nuclear endosperm. Finally the enucleate nodules coalesce and this together with the centripetal growth of endosperm cytoplasm results in the filling up of the central vacuole. Wall formation is centripetal and progressive. Enlosperm becomes ruminate or wavy in outline in a mature seed. Embryo development of *Passiflora foetida* conforms the *Myosurus variation* of Onagrad type.

Both the integuments at the mature embryo sac stage are three layered and take part in the construction of seed coat. The epidermal cells of the seed coat are slightly elongated and smoothly cuticularised and those of the middle layer are tangentially elongated. Cells of the inner epidermis of the outer integument are radially elongated and possess starch grains. Inner part of the seed coat originates from the inner integument. Its outer epidermal cells are lignified, radially elongated and form the characteristic sclerenchyma layer of the seed coat. Cells of the middle layer of the inner integument get their inner walls thickened and persist, while those of the inner layer remain small, stain dark with safranin and persist. The seed coat shows ruminations on the flat surfaces of seed.

The mature seed is enveloped in a succulent aril.

55. Studies on the persistent pollen tube of the Cucurbitaceae.

DALBIR SINGH, Jodhpur.

The paper deals with the pollen tube of *Citrullus colocynthis* schrad., *Ctenolepis cerasformis* Naud., *C. garcini* Naud., *Cucumis melo* L. var. *pubescens* Willd., *Cucumis sativus* L., *Cyclanthera pedata* Schrad., *Dicaelospermum ritchiei* Clarke, *Edgaria darjeelinensis* Clarke, *Gymnopetalum cochinchinense* Kurz., *Herpetospermum caudigerum* Wall., *Luffa acutangula* (hermaphrodite var.), *L. graveolens* Roxb., *Melothria maderaspatana* Cogn., *Momordica charantia* Linn., *Sechium edule* S.W., and *Trichosanthes cucumerina* Linn. The pollen tube is porogamous and persistent in all the plants. The course of the pollen tube is straight or sinuous in the nucellus. The persistent pollen tube has a thick wall and scanty cytoplasm. In the ovules of *Cyclanthera, Dicaelospermum, Edgaria, Herpetospermum* and *Melothria* it is observed to dilate in the nucellus. The dilation of the tube does not show any positive correlation with the starch grains of the integuments.

56. A further contribution to the endosperm of the Cucurbitaceae.

DALBIR SINGH, Jodhpur.

The paper deals with the structure and development of the chalazal endosperm haustorium in *Cyclanthera pedata* Schrad., *Dicaelospermum ritchiei* Clarke, *Edgaria* *darjeelingensis* Clarke, *Herpetospermum caudigerum* Wall., *Luffa acutangula* (hermaphrodite var.), and *L. graveolens* Roxb.; and the behaviour of the endosperm nuclei during advanced stages of seed development in *Cucumis sativus* L., *Cucurbita pepo* L., *Cyclanthera pedata* Schrad., *Herpetospermum caudigerum* Wall., S.W. and *Trichosanthes cucumerina* Linn.

The endosperm is free nuclear. It differentiates into an upper vesicular part, the endosperm proper and a narrow tubular chalazal haustorium. Later on, the vesicular part becomes cellular while the chalazal caecum remains coenocytic throughout its life in these plants. In *Dicaelospermum*, *Edgaria*, and *Herpetospermum* a free nuclear part is, however, left between the narrow caecum and the cellular endosperm. The haustorium remains active up to the heart-shaped stage of the embryo, after which it shrinks and finally disappears. With the decline of the haustorial activity the peripheral cells of the chalazal part of the endosperm proper bulge out. In *Luffa* species these cells divide and form short cellular mounds, the secondary haustoria. It is shown through discussion that the cellular or coenocytic nature of the haustorium depends upon the length attained by it.

The endosperm nuclei during advanced stages of seed development increase in size and become lobed, but in the haustorium of *Cyclanthera* they become vermiform. Simultaneously the nucleoli also acquire different shapes, become vacuolate, and show fragmentation. Deeply staining granular bodies and vacuoles also arise in the nucleoplasm. In *Cucumis sativus* fusion of nuclei is also observed. These are probably the steps leading to the disintegration and final resorptionof of endosperm nuclei by the growing embryo.

The endosperm in the Cucurbitaceae is mostly utilised and in mature seed only one or two peripheral layers are left surrounding the embryo.

57. A contribution to the morphology and embryology of Dicentra scandens Walp.

DALBIR SINGH, Jodhpur and D. S. NEGI, Norman, U.S.A.

The flowers of *Dicentra scandens* Walp. are borne on terminal racemose clusters. Each flower is pale yellow in colour and is subtended by a bract. Its floral parts arise in acropetal succession of two sepals, four petals in two whorls, six stamens forming two groups of three each and a superior bicarpellary, and unilocular pistil with parietal placentation.

The flower receives a branch supply from which the first trace to depart is that of the bract. The bract supply trifurcates after entering it. The remaining cylinder breaks into smaller bundles and, later on, they fuse to form a stellate structure. At this stage from anterior and posterior positions originates the vascular supply to the sepals. Each sepal receives three traces. This is followed by the supply to the outer petals and that of the inner ones in sequence. Each stamen receives three traces, the median which passes to the dithecous anther originates in lateral position, while the other two originate in anterior and posterior positions. They enter the monothecous anthers only higher up after deviating from their place of origin. Thus, the three anthers of one stamen group receive their supply from three diverse sources. The remaining bundles of the cylinder form the carpelly supply.

Ovules are anatropous, bitegmic and crassinucellate. They develop a hypostase below the embryo sac after fertilisation. Vascular supply to the ovule terminates at the chalaza. Development of embryo sac is of Polygonum type.

Microsporogenesis is simultaneous and cytokinesis is by furrowing. Pollen grains are shed at bi-celled stage. They are colpate and triporate. They may germinate *in situ* and rarely while still in tetrads. Frequently branching of the pollen tube is observed.

Flowers are cleistogamous and protandrous. Germinated pollen grains on the stigma show considerable coiling before entering into the stigmatic tissue. Pollen tube enters the embryo sac through the micropyle and in doing so destroys one of the synergids.

The enlospeerm development is nuclear and the first division of the zygote is transverse. Polyembryony is also recorded.

Seed coat develops from both the integuments. Initially the outer integument is two layered and the inner three cell-layered, except at their tips where the thickness is more. During seed devlopment all the layers disorganise except the outer epidermis of outer integument and the inner epidermis of the inner integument. The cells of the former get cutinised, turns black and form the testa, while those of the latter remain small and thinwalled. The mature seed is albuminous.

On the basis of these studies the nature of the androecium and the systematic position of *Dicentra* in the family is discussed. The androecium is shown to consist of six stamens, diadelphous, two dithecous lateral and four nedian, monothecous and reduced. Reduction of the median stamens is attributed to the developmental pressure. The genus *Dicentra* is considered as least specialised among *Dicentra, Corydalis* and *Fumaria*.

58. Structure and development of ovule and seed of Viola tricolor L. and Ionidium suffruticosum Ging.

DALBIR SINGH, Jodhpur.

Ovules are anatropous, crassinucellate and bitegmic both in *Viola tricolor* and *Ionidium suffruticosum*. Transverse section of an ovary shows that there are many ovules on each placenta in *V. tricolor* while in that of *I. suffruticosum* there are only two ovules on each placenta. Both integuments of an ovule are two layered to start with but ultimately they become three layered due to the tangential division in the cells of the inner epidermis. In *Viola* cells of the middle layer of outer integument develop tannin. The ovular supply after entering the chalaza fans out in an inverted umbrella-like structure.

The pollen tube enters through the micropyle and is rarely persistent. Double fertilisation is observed in both the plants. One embryo sac of *Viola tricolor* is observed to show reversed polarity.

Endosperm development is free nuclear and wall formation centripetal and progressive. The embryo development follows the Asterad type. Rarely a linear tetrad of proembryo is observed in *V. tricolor*....

Seed coat develops from both the integuments and in its formation only the middle layer of the inner integument disintegrates. All other layers persist and undergo certain changees. Seed epidermis, formed of the outer epidermis of the outer integument, is cuticularised; and its cells in *V. tricolor* have reticulate thickening, while lamellate in *L. suffruticosm*. The cells of the middle layer of the outer integument only persist in both the plants. In *Ionidium* they become thick-walled and elongate at right angles to the cells of the main mechanical layer. The cells of the inner epidermis of the outer integument develops calcium oxalate crystal, one in each cell. and form the third layer of seed coat. Outer epidermis of inner integument forms the main mechanical layer of the seed coat. Its cells are elongated tangentially or along the long axis of the seed. In *V. tricolor* they possess spindle shaped multinucleolate nucleus. They become strongly lignified and have pits on their walls. The cells of the inner epidermis develop cellulose thickening and persist in a mature seed.

The chalazal part of the nucellus develops two hypostase one immediately below the embryo sac and the other in line with the integuments. The cells of the former develop cellulose thickening while that of the latter full of tannin. The chalazal cells lying outside the tannin cells of the lower hypostase, later on, become sclerified and join with the lignified cells of the outer epidermis of outer integument, forming a continuous sclerenchyma sheath.

The mature seeds are pear-shaped and possess a hump-like aril of the raphe. On the basis of embryological and seed coat characters the relationship of Violaceae is discussed with other related families and shown that the seed coat characters provide fresh evidence in favour of Hutchinson's view for putting Violaceae and Resedaceae together.

59. Palynological studies on *Sesbania sesban* Linn (*S. ægyptiaca* Pers.).

R. M. DATTA and P. K. BISWAS, Calcutta.

Pollen grain is 3-colpate with 3 germ pores, each situated in a colpa almost equidistant from each other. Sexine is thicker than nexine; its surface undulating, reticulate with L-O pattern. No pouting at the Colpi is observed as previously recorded by Datta and Dana (in press) in case of *S. aculeata* and *S. speciosa*. Nexine shows 3 brghtly stained thickenings in the tip regions of 3 germ pores. Comparative measurements show that this species is intermediate between the outer species studied by Datta and Dana previously. Evolution in this genus is of divergent type.

60. Preliminary observations on the rate of pollen tube growth and pollen tube mitosis in *Crotalaria saltiana* (=C. striata).

R. M. DATTA and P. K. BISWAS, Calcutta.

Maximum pollen tube length attained *in vitro* was 980 μ. It continues to grow in culture for 7 hours. 80% of the pollen grains germinated. Callose plugs were observed in a specific type of staining. Its frequency and measurements are noted.

The tube nucleus is found to precede the generative cell, which divides normally with regular equatorial division. No cell plate is discernible in anaphase or telophase. Cytokinesis takes place by furrowing. Two spindle shaped sperms are formed.

61. Pneumatophores in *Cocos Nucifera*

T. A. DAVIS, Calcutta.

Several species of palms manifest certain hydrophytic adaptations. The presence of numerous tiny dull-white outgrowtwhs, each having a perforated head, on the main roots as well as root-lets of palms like the coconut, which help the tips of roots buried deep in the soil under conditions of poor aeration, communicate with the atmosphere for the exchange of gases, is one of them. The rest of the root surface is somewhat impervious to air on account of the hard hypodermal layer. Such short roots which resemble the jasmine bud although vary in size, according to the thickness of the root from which they start, are to be considered as "pneumatophores" or "respiratory roots" and they simulate in function the pneumatophores of *Rhizophora* or *Avicinnia*.

The origin, development, distribution and structure of the breathing root in coconut have been studied. The first breathing root is formed within six months after the germination of the nut has commenced and it it originates like any other root-let. The frequency of the breathing roots gets reduced as their vertical penetration in the soil increases. The structure of the dermal portion of the breathing root differs widely from that of a root-let.

62. Development of the Seed of *Trianthema portulacastrum* Linn.

V. R. DNYANSAGAR and S. R. MALKHEDE, Amraoti.

The ovule is amphitropous, crassinucellate, bitegmic and is surrounded by 2-layered aril. The mature megagametophyte, a 7-celled structure, consists of a 3-celled egg apparatus, an endosperm mother cell with fused polar nuclei and 3 ephemeral antipodals. Double fertilization occurs within 24 hours after pollination. The endosperm follows the nuclear type of development. The process of cell formation in the endosperm commences from the micropylar end between 6 and 7 days after pollination and then it gradually spreads towards the chalazal end. The endosperm, however, remains free nuclear in the form of a tubular process up to the 11th day after pollination. This process absorbs nutritive materials from the chalazal tissue. No trace of endosperm is left in the mature seed. Embryo development follows the Linum variation of Solanad type. The mature embryo is curved and in its curve there is left a part of the nucellus forming the perisperm. The seed matures 16-17 days after pollination. Its testa is composed of 6 layers, of which 2 belong to the aril, 3 to the outer integument and the innermost represents the inner layer of the inner integument.

63. Gametophytes of *Campynema lineare* Labill. with special reference to its systematic position.

B. S. M. DUTT, Waltair.

The paper deals with the male and female gametophytes of *Campynema,* a monotypic endemic plant occurring in Tasmania.

The anther shows the epidermis, two middle layers, the secretory tapetum and microspore mother cells which divide by successive method. The anthers are extrorse and the pollen grains are 1-sulcate and are shed at two celled stage.

The gynoecium has three free styles.,The numerous anatropous ovules are borne on axile placentae in the tricarpellary trilocular inferior ovary. The hypodermal archesporial cell cuts off a parietal cell and the megaspore tetrads are T-shaped. The embryo sac develops according to the Polygonum type. The micropyle is organised by the inner integument which is wider at the apex.

In the formation of a secretory tapetum as well as a parietal cell in the ovule and the organisation of a micropyle by the inner integument alone, *Campynema* shows a marked departure from the other members of Hypoxidaceae so far investigated. In addition to the embryological features mentioned, the Campynematoideae comprising *Campynema* (distribution : Tasmania) and *Campynemanthe* (distribution : New Caledonia) are characterised by two distinct morphological features, namely, the extrorse nature of the anthers and three free styles and are, therefore, not closely related to the other membrs of the Hypoxidaceae o Hutchinson. It seems best to include *Campynema* under a separate sub-family Campynematoideae under the Amaryllidaceae. A morphological study of its pollen by Erdtman (1952) also lends additional support for such a conclusion.

64. Embryology of *Curculigo crassifolia* Hook. f. with special reference to its systematic position.

B. S. M. Dutt, Waltair.

The archesporium in the anther consists of a plate of three hypodermal archesporial cells. The anther shows the epidermis and four to five parietal layers of which the innermost becomes the amoeboid tapetum. The divisions of the microspore mother cells are successive and the pollen tetrads are isobilateral or tetrahedral. The haploid chromosome number is nine. The mature anther consists of the remnants of the epidermis and two hypodermal layers with fibrous thickenings. The pollen grains are shed at the two-celled stage.

The ovules are anatropous, bitegmic and tenuinucellate. The megaspore tetrads are T-shaped. The embryo sac is of the polygonum type. The endosperm is of the helobial type with a smaller chalazal and a much larger micropylar chamber. Free nuclear divisions take place in both the chambers but towards later stages cell wall formation takes place in both the chambers, a feature not so far described in any other member of the Hypoxideae.

The embryo conforms to the Asterad type and keys out to the "Anthericum Variation".

On embryological evidence *Curculigo* can be included under the Hypoxideae.

65 Post-glacial vegetational history of the Kashmir Valley.

GURDIP SINGH, Lucknow.

This paper deals with the pollen-analytical investigations of Post-glacial deposits from four sites namely Toshmaidan, Braman, Walanwar and Damamsar, distributed over the Kashmir Valley slopes of the Pir Panjal Range. The study reveals for the first time the Post-glacial vegetational history of the Kashmir Valley especially in regard to the Post-glacial climatic alterations, biotic influences on vegetational development and the phytogeography of the region.

The entire vegetational sequence is divisible into eight vegetational stages. The forest history began with an open vegetation with conifer woods consisting mainly of blue pine and cedar. During the period of increasing warmth, the wormth and moisture demanding broad-leaved elements such as oaks, alder, birch (*Betula alnoides*), elm, walnut, maple and *Rhus* immigratd. Later, during the period of maximum warmth forests comprising dominantly of the broad-leaved elements established themselves. Afterwards, with the return of colder conditions the conifers reestablished themselves in this region. The conifer woods comprised largely of *Abies* and *Pinus wallichiana*.

Some of the changes in the vegetational sequence are also believed to have been induced by the Prehistoric Man's direct or indirect influence on vegetation. Besides, the evidence of Maize cultivation in the past has also been brought out.

The bearing of this work on the history of some of the mesophytic elements such as oaks, *Alnus* and *Betula alnoides* which are today absent from the Kashmir Valley is also discussed.

66. Growth of embryo fragments of Dendrophthoe falcata (L.f.) Ettings.

B. M. JOHRI and Y. P. SINGH BAJAJ, Delhi.

Johri and Bajaj (1961) reported earlier that the mature embryo of *Dendrophthoe falcata* can be successfully grown on synthetic medium under aseptic conditions. A discoid hold-fast and a pair of leaves develop in about 5 weeks. Fragments of the embryo were grown on modified White's medium containing sucrose (4 per cent), IAA (0·5 ppm) and casein hydrolysate (500 ppm).

The cotyledons alone form a mass of callus which fails to differentiate into a hold-fast and shoot and turns brown in 6 weeks while the radicular portion only, develops a marginal meristem and gives rise to a number of discoid hold-fasts in succession. In the latter case callus may also develop which bears papillate outgrowths. If the plumular region remain intact with the cotyledons or the radicular portion normal seedlings with one pair of plumular leaves are produced in 3 to 5 weeks. However, if the central part of the embryo with the plumular portion is grown, it produces a seedling in 3 weeks and the polarity is maintained i.e. hold-fasts develop only from the radicular end. Occasionally callussing may occur at both the cut-ends forming a dumbbell-shaped structure and differentiation into hold-fasts and shoot does not occur. Embryo incised longitudinally only in the radicular portion produces two sets of hold-fasts. If the incision is deeper involving the plumule and half the length of the cotyledons, two seedlings develop which can be separated and grown independently. If the incision divides the embryo into unequal halves, the resulting seedlings are also unequal.

Thus, the plumular region with or without the radicular portion or cotyledons, is capable of producing normal seedlings. Whether the stem tip alone will produce a normal seedling is under investigation.

67. The Structure and Development of Seeds in Convolvulaceae Spomoea Species.

J. S. JOS, Agra.

S. pes-tigridis (Linn.) thrives in waste places during rainy season, while S. reptans (poir) is a hydrophyte. The gynaecium of the pentamerous flower is 3 or 4 chambered, and each loculus contains one or two anatropous ovules which develop from an axile placenta. Ovules are tenuinucellate, unitegmic and the micropyle is formed by the massive integument. The cells of the integument are homogeneous. The nucellus is ephemeral.

The cells of the placenta just around the funicle form an obturator, which occupies the space between the carpellary wall and the micropylar region of the ovule. The development of the female gametophyte follows the polygonum type and the embryo sac is 8 nucleate. The antipodals, however, disappear very early. The embryo sac during the development of seeds become two lobed.

The first division of the zygote is transverse. The embryo proper is derived from the terminal cell. The embryogeny follows that of the caryophylloid type, Fumaria variation. A few linear embryos are noted where the longitudinal walls have not been laid. The suspensor is very massive. The mature embryo has folded cotyledons. The endosperm is of nuclear type which ultimately becomes cellular.

The seed coat consists of the epidermis, the hypodermis and two or three layers of thick walled palisade sclerenchymatous cells, but in the micropylar region 5 layers of radially stretched cells are present. There are about ten to fiften layers of palisade cells throughout the integument.

In S. pes-tigridis polyembryony occurs but the origin of multiple embryos could not be traced.

68. Emryological Studies in Gentianaceae. 1. Gentianoideae.

H. MAHESWARI DEVI, Waltair.

The present embryogical investigation of the two sub-families of Gentianaceae, Gentianoideae and Henyanthoideae, was undertaken with a view to examine the bearing of the evidence gathered on the relationships of the two sub-families.

The structure and development of another, pollen ovule, megasporogenesis, female gametophyte, fertilisation endosperm and embryo have been studied in the following representatives of the sub-family gentianoideae.

(1) *Exacum bicolor,* Griseb, (2) *E. Pumilum* Griseb, (3) *E. Petiolare* Roxb., (4) *Canscora Diffusa* R. Br. and (5) *C. Decussata* Roem & Sch.

The archesporium in the another lobe consists of a plate of 5-10 rows of cells and each row is 6-16 cells deep. Two walls layers occur in *Canscora diffusa C. decussata* and *Exacum pumilum*, three wall layer in *E. Petiolare* and four in *E. bicolor*. Fibrous endothecium is absent in the three species of *Exacum*. In the species of *Canscora* the sub-epidermal layer develops into the fibrous endothecium. The anther tapetum is of the amoeboid type in the two species of *Canscora* and secretory type in the three species of *Exacum*. Small granular thickenings are present on the inner walls of tapetal cells in *Exacum bicolor* and *E. Pumilum*.

Division of pollen mother cells is of simultaneous type. Cytokinesis is by furrowing. Both bilateral and tetrahedral tetrads are formed. The pollen grains are three celled and triporate. The exine shows minute projections.

The ovary is superior and bicarpellary syncarpous. It is unilocular in *Canscora diffusa and C. decussata* and bilocular in the species of *Exacum*. The ovule is unitegmic, tenuimucellate and anatropous.

The primary archesporium is unicellular. A linear tetrad of megaspores is formed. The chalazal megaspore of the tetrad develops into the eight nucleate embryo sac according to the plygonum type. Three uninucleate antipodal cells are formed.

Fertilisation is porogamous. Usually, the pollen grains are monosiphonous, but in about 10% of cases of *C. diffusa*, two pollen tubes are formed per pollen grain.

Endosperm is of the nuclear type. After a few free nuclear divisions wall formation commences from the periphery to the centre ultimately filling the whole embryo sac with cellular tissue. Starch and albumen crystals from the reserve food in the cells of the endosperm.

The terminal cell *ca* alone contributes to the development of the embryo proper and the basal cell *cb* contributes to the formation of the suspensor. This is characteristic feature of the solanad type. Further in the destination of the cells of the tetrad it closely resembles physalis II variation. Thus the embryo development conforms to physalis II variation of solanad type.

The outer epidermis of the integument forms the seed coat.

69. Embryological Studies in Gentianaceae. 2. Menyanthoideae.

H. MAHESWARI DEVI, Waltair.

The present paper deals with the structure and development of anther and pollen, ovary, ovule, megasporogenesis, embryo sac, fertilisation, endosperm, embryo and seed coat in *Limnanathemum indicum* Thw and *L. Cristatum* Griseb.

The archsporium in the anther lobe consists of a plate of 5-10 rows of cells. The anther wall consists of the epidermis, two wall layers, and the tapetum. The sub epidermal layer develops into the fibrous endothecium. The tapetum is of the secretary type. Nuclear divisions and fusions of tapetal cells are seen. Division of pollen mother cells is of simultaneous type. Cytokinesis is by furrowing. Both bilateral and tetrahedral tetrads are formed. The pollen grains are three celled and triporate. The exine shows rod like thickenings in it.

The ovary is superior, bicarpellary syncarpous and unilocular with two to four parietal placentas. The ovule is unitegmic, tenuimucellate and anatropous. An integumentary tapetum has been differentiated in both the species.

In one case of *L. cristatum*, fused ovule has been observed.

The primary archesporium is unicellular. A linear tetrad of megaspores is formed. The chalazal megaspore of the tetrad develops into the eight nucleate embryo sac. Three uninucleate antipodal cells are formed.

Fertilisation is porogamous.

Endosperm is of the cellular type. The cells of the endosperm are filled with protein bodies as reserve food.

Embryo development keys out to the senecio variation of Asterad type in both the species studied.

In *Limnanthemum indicum,* in one case, however, two embryos were seen in addition to the zygotic embryo. Judging from their position, they seem to be developed from the two synergids.

The outer epidermis of the integument forms the seed coat.

On the basis of morphological, anatomical (both vegetative and floral) and embryological characters, the two sub-families, Gentianoideae and Menyanthoideae of the family Gentianaceae, may be raised to the rank of independent families namely, the Gentianaceae and Menyanthaceae.

70. Replacement of Inflorescence by Turions in Aponogeton crispum Thunb.

H. P. MEHTA, Varanasi.

Aponogeton crispum Thumb. is a common aquatic plant of the ponds of Varanasi. It is a scapigerous freshwater herb with tuberous root stock. In the month of August as the ponds are filled up, it starts flowering. The scape is cylindrical and smooth. Its length varies with the depth of water. The spike is 5 to 12 cm. long, simple, solitary and densely flowered. All the leaves, which are membraneous remain submerged and only the spike projects out of the water. By the end of November the water level in these temporary ponds falls gradually when fruit formation starts. In one of the ponds, as the water level fell, floating leaves which are not membraneous as the submerged ones developed. In these plants some of the scapes were obsrved to bear a turion in the place of inflorescence. The turion proliferates giving rise to two, three or more leaves with long petiols, which are all floating ones. The turions are bulb-shaped.

The study of relation existing between the turions and the inflorescence and the factors involved in the production of turions are of interest.

Ecological conditions under which the plants were growing are given and further study regarding the nature and factors, is in progress.

71. Embryology of Plantago coronopus Linn.

R. C. MISRA, Lucknow.

Plantago coronopus flowers arise on a long spike. The are bisexual, actinomorphic and tetramerous. The ovary is bicarpellary and syncarpous. In each locule of the carpel two, unitegmic, anatropus, ovules arise on an axile placenta. One or two archesporial cells differentiate in an ovule, but only one functions ultimately to become directly a megaspore mother cell. The embryosac development is of the 'Polygonum type'.

After double fertilization, the primary endosperm nucleus divides and the daughter nuclei are separated by a transverse wall to form two cells. The chalazal cell becomes binucleate and functions as the endosperm haustorium. The micropylar cell undergoes two divisions to form four cells. The first division is longitudinal while the second is transverse. The upper two cells function as micropylar haustoria and the remaining two, by series of divisions, from the endosperm proper. The haustoria grow to reach the placenta. The embryogeny conforms to the Onagrad type.

72. Leaf structures in grasses.

B. N. MULAY, B. D. DESHPANDE and MISS N. LALITHA Pilani.

(i) Leaf anatomy of the following grasses was investigated : Subfamily Pooideae :—

1. *Arundo donax* L. 2. *Eragrostis tremula* Hochst 3. *Dactyloctenium aegyptiacum* L. 4. *Desmostachya bipinnata* Stapf. 5. *Aristida mutabilis* Trin and Rup. 6. *Tragus biflorus* Schultz. 7. *Perotis indica* O. Ktze. Subfamily Panicoideae :—8. *Cymbopogon parkerii* Stapf. 9. *Erianthus munja* O. Ktze. 10. *Brachiaria ramosa* Stapf. 11. *Panicum antidotale* Retz. 12. *Digitaria adscendens* (HBK.) Hener. 13. *Cenchrus ciliaris* L. 14. *C. barbatus* Schum 15. *C. preuri* Kunth 16. *Setaria verticillata Beauv.*

(ii) Following taxonomic criteria were used for classification :

1. Presence or absence or ill-developed midrib region. 2. Occurrence and arrangement of bulliform cells. 3. Single or double bundle sheath, with or without chloroplasts. 4. Nature of sheath cells. 5. Arrangement of chlorenchyma, whether regular in radial bands, or irregular or all around the bundles.

(iii) Based upon the above criteria the following groups are recognised : Subfamily Pooideae :—without prominent midrib region.

1. Arundinoid type. 2. Eragrostoid type. 3. Aristidoid type. 4. Chloridoid type. Subfamily Panicoideae :—with prominent midrib region. 5. Panicoid type. 6. Andropogoneae type. 7. Sacchariferae type.

(iv) The authors recognise the types suggested by Brown (1958) but do not agree with him for inclusion of tribes Eragrosteae and Zoysieaein "Chloridoid" type and so a type "Eragrostoid" is suggested. Authors would suggest that type Panicoid" may be restricted only to the genera *Panicum* and *Brachiaria* because they differ considerably from other grasses in their leaf structure.

73. Lateral bud development and flowering of branches in teak *(Tectona grandis L.F.)* in relation to light.

K. K. NANDA, Dehra Dun.

This paper deals with observations on the branching behaviour and flowering of the main shoot and branches of teak.

The flowering of the main shoot as well as branches is terminal. In close stands flowering occurs only in dominant and co-dominant trees and is confined to the upper parts which are exposed to bright sunlight. There are no inflorescences either on the lower parts of these trees or on those which grow under a thick canopy. Flowering is profuse on all sides in trees which are growing singly. As against this in trees growing on the border of thick stands flowering is confined to the lighted side and is more or less completely absent on the shaded side. These differences in growth and flowering are ascribed to the differences in the intensity of likht to which these plants are exposed while growing in different situations. It is shown that the curtailment of light delays not only the initiation of flower buds but also their development into flowers as well as in the production and ripening of fruits.

The emergence of branches and their flowering appears to be controlled by factors which are related to ageing or completion of the main shoot or the branch on which these are produced. The first branch emerges from the node immediately below the previous years inflorescence and the second one from the node next below it and so on. The flowering of these branches also follows the same order. The basipetal sequence in the emergence and flowering is exhibited even by secondary tertiary, quarternary and further branches.

The results are discussed in the light of branching and flowering behaviour of other plants.

74. Embryological studies in *Acalypha alnifolia* Klein ex Willd.

PIRATLA NARASIMHA RAO, Waltair.

The paper deals with the microsporogenesis, male gametophyte, structure of the ovary, ovule and embryosac in *Acalypha alnifolia.*

The wall of the anther consists of the epidermis, fibrous endothecium, single middle layer and tapetum. Tapetum is of the secretory type. Divisions of the microsporemother cells are simultaneous. Cytokinesis takes place by furrowing. Microspore tetrads are tetrahedral or decussate. The mature pollen grains show three or four germ pores and are shed at the thee celled stage.

The ovules are anatropous, bitegmic and crassinucellate. The obturator arises from the placenta and extends into the micropyle. The embryosac is tetrasporic and sixteen nucleate. The organization of the matcre embryosac is of the modified Penaea type and is similar to that of *Acalypha indica* (Maheswari & Johri, 1941).

75. On the development of endosperm and embryo in *Lindenbergia indica* (Linn.) Kuntze.

NIRANJAN PAL, Calcutta.

The first division in the endosperm is transverse followed by a vertical division in the micropylar chamber. This vertical wall is laid down only at the end on the transverse wall. Then these two cells divide again in the transverse direction separating two cells in the middle tier and two free nuclei at the micropylar end. These two free nuclei divide once and a four-nucleate micropylar haustorium differentiates. The chalazal chamber, on the contrary directly functions as the chalazal haustorium. The middle tier of two cells gives rise to the proper endosperm tissue. The cells of the endosperm at the micropyylar end form the isthmus and function as a conductive and nutritive tissue. Those cells lying at the chalazal end, on the other hand, do not show any specialization. The peripheral cells in the endosperm, at a later stage of development become active and digest the surrounding tissues. The mature seed contains only two layers of endosperm.

Before the occurrence of the transverse division, the zygote elongates enormously. The basal cell *cb* divides twice in succession forming cells *d* (which acts as the hypophysial cell), *f*, *n* and *n'*. The terminal cell *ca* undergoes two successive vertical divisions followed by a transverse division in each of these cells. Thus an octant in two tiers is derived. Next division in each of the octant cells is periclinal. Cells from both tiers *i* and *l'* contribute in the formation of the cotyledons.

76. The development and structure of the endosperm and embryo in *Mazus japonicus* (Thumb.) Kuntze.

NIRANJAN PAL, Calcutta.

The first division in the endosperm is transverse, the chalazal cell divides vertically and these two cells constitute the chalazal haustorium. Later, this is transformed into a two-nucleated cell. The micropylar chamber is subjected to a longitudinal division followed by the formation of a transverse wall in each of the daughter cells and the two cells in the micropylar tier differentiates into the micropylar haustorium which also later become single-celled. The two nuclei become hypertrophied and the haustorium develops tubular branches which grow towards the chalaza. The two cells in the middle tier undergo two successive transverse divisions followed by divisions in all directions and gives rise to the proper endosperm tissue. The endosperm cells at the micropylar end are conductive and lie in a narrow zone forming an isthmus. After the precocious disorganization of chalazal haustorium, the endosperm cells at the chalazal end form a complex multinucleate amoeboid mass of protoplasm which also functions as a conductive organ. At a later period of growth, the peripheral cells of the endosperm become organized into a digestive tissue. Mature seed contains two layers of endosperm cells.

The zygote attains a great length prior to a transverse division. The terminal cell *ca* undergoes two successive vertical divisions at right angle to each other followed by a transverse division in each of these cells resulting in the formation of a terminal octant in two tiers. Then periclinal divisions occur in these cells. The cotyledons of the embryo are contributed by both tiers *l* and *l'*. The basal cell *cb* divides transversely twice in succession when cells *d* (which is the hypophysial cell), *f*, *n* and *n'* are derived.

77. A contribution to the Embryology of Combretaceae.

P. S. PRAKASA RAO, Waltair.

The present paper deals with microsporogenesis, male gametophyte, megasporogenesis and female gametophyte of *Terminalia catappa* Linn., *Combretum decandrum* Roxb. and *C. ovalifolium* Roxb.

There are ten stamens in two whols of five each. The anther consists of the epidermis, the fibrous endothecium and three to four middle layers of which the innermost forms the secretary tapetum. The tapetal cells become two nucleate. The divisions of the microspore mother cells are simultaneous and cytokinesis is by furrowing. The pollen tetrads are isobilateral and tetrahedral. The pollen grains are shed at two-celled stage.

The unilocular ovary is inferior and contains two to three pendulous, anatropous and bitegmic ovules. The archesporial cell cuts off parietal cell. The megaspore mother cell undergoes the two meiotic divisions resulting in a linear tetrad of megaspores of which the chalazal is functional. The embryo-sac development is of Polygonum type. The antipodal cells are ephemeral.

The funicular obturator is present in both the species of *Combretum* while it is absent in *Terminalia catappa*.

Work on other members of Combretaceae is in progress.

78. Studies in pollengrain germination of certain plants of Malvaceae and related families in vitro.

S. S. PRASAD, Muzaffarpur.

Pollen grains of *Hibiscus vitifolius* L., *Hibiscus esculentus* L., *Hibiscus mutabilis* L., *Hibiscus rosasinensis* L., *Sida spinosa* L., *Abutilon indicum* G. Don., *Malachra capitata* L., *Althaca rosea* L., *Bombax malabaricum* DC. and *Grewia asiatica* L. were collected soon after anthesis and dusted on slides smeared with sucrose-agar-gelatin medium. The laboratory temperature varied between 26° and 27° centigrade. The pollen grains began to germinate within ten minutes of dusting. The growth was very rapid during the first half an hour after dusting. After thirty minutes the growth slowed down and at the end of an hour practically it ceased. Out of ten species of plants chosen for study, the pollen grains of only five germinated while those of the rest did not respond in vitro. Such species proved obstinate and even ·01% Boric acid and higher percentage of sucrose solutions failed to induce germination of their pollen grains.

The results of the observations are tabulated below :

Name of species.	Percentage of germination.	Type of germination.	Longest tube observed.
Hibiscus citifolius L.	95%	Polysiphonous, no branching, up to 12 tubes observed emerging out of a single pollengrain.	173·60 μ
Hibiscus esculentus L.	94%	Polysiphonous, tubes profusely branched.	1557·00 μ
Hibiscus mutabilis L.	20%	Polysiphonous, no branching.	86·80 μ
Hibiscus rosasinensis L.	No germination	——	——
Sida spinosa L.	40%	Monosiphonous, no branching.	43·40 μ
Abutilon indicum G.Don.	4%	Monosiphonous, no branching.	41·30 μ
Malachra capitata L.	No germination	——	——
Althaea rosea L.	No germination	——	——
Bombax malabaricum DC.	——	——	——
Grewia asiatica L.	——	——	——

Thus we find that pollengrains of some of the species germinated readily while those of others proved obstinate in vitro. In the species of *Hibiscus* polysiphonous tubes are observed but branching is seen only in *Hibiscus esculentus L.* Species of *Sida* and *Abutilon* produce unbranched monosiphonous tubes. Work on the effect of amino-acids, sugars and vitamins on germination of pollengrains is in progress.

79. Palynological investigation of Cucurbitaceae (Part II).

MISS PRITI AWASTHI, Lucknow.

Present study is a further contribution to our knowledge of pollen morphology of Cucurbitaceae plants. Eighteen species and their varieties belonging to the following 12 genera have been studied and their palynograms described. *Actinostemma tenerum, Blastania garcinii, Citrullus vulgaris, Citrullus vulgaris* var *fistulosus, Coccinia indica, Cucumis melo* var *utilissimus, C. sativus, C. trigonus, Gompogyne cissiformis, Leginaria vulgaris* (round fruited variety), *L. vulgaris* (long fruited variety), *Luffa acutangula, L. cylindrica Monordica balsamia, M. Charantia, M. dioica Mukia scabralla, Trichosanthe cuccumeria, T. dioica* and *Zehneria umbellata.* Abnormalities have been observed in the pollen of cultivated species, these include increase in the number of apertures and the syncolpate conditions. It has been found that the general morphological pattern of the species varies slightly from variety to variety. At the same time the percentage of abnormalities also varies from variety to variety. The full significance of this is being studied.

80. On the morphology of the pollen grains of two species of Cucurbita, L.

MISS PRITI AWASTHI, Lucknow.

The present communication, pollen morphology of two species of *Cucurbita* namely *C. pepo* anl *C. Moschata* is presented. Fresh material were collected from the vegetable farm of the Agricultural College (Kanpur), and slides were prepared according to the acetolysis method recommended by Nair (1960), in which acetolysed pollen grains were mixed with safranin stained unacetolysed ones. During the morphological observations, percentages have been taken of (i) size variations, (ii) grains with various excrescences types, (iii) abnormal grains, (iv) sterile grains. "Giant grains" with the size of 304 μ have also been found rather unusual among angiosperms. A large range of size variation is perhaps pointer to the polyploid nature of the species. Grains are panporate and spinate. Pollen grains of *C. pepo* do not show such a great variation in pollen morphology as *C. Moschata*. Grains of *C. pepo* are characterised by having smaller number of pores than those of *C. moschata*, and spines with acute tips.

81. Studies in the Seedling Anatomy of *Mirabilis jalapa* L.

RAMJI SHARMA, DHAR M. P. and (MISS) MALTI PATHAK, Indore.

The shoot apex has a three layered tunica, the second layer of which initiates leaf primordium. Each primordium differentiates an arc of meristem that extends basipetaly in the stem and the two arcs descending from the two opposite leaf primordia meet together to form a continuous ring of residual meristem. Procambial strands are differentiated from this tissue : three in each leaf, and all the six strands of leaf pair at each node descend directly in the internode below, connected together by the residual meristem ring. In the internode region too, the residual meristem differentiates new procambial strands that mature into normal collateral, endarch bundles. The residual meristem, soon after, begins to produce parenchyma inwardly so that the newly formed bundles get separated centrally from the meristematic ring. This also applies to foliar traces which are the first to separate. Foliar traces have a course as described by De Bary (1884). In the hypocotyl, four bundles with alternating protoxylem groups are seen : the two protoxylem groups in the cotyledonary plane are directly descended from the cotyledons, while those in the inter-cotyledonary plane are formed afresh. This tetrarch condition becomes diarch lower below due to fading away of the protoxylem groups in the intercotyledonary plane.

82. Studies in the Embryology of *Canscora diffusa* L.

RAMJI SHARMA, DHAR and S. R. UPADHYAY, Neemuch.

The microsporangium differentiates from a five layered meristematic zone in each anther lobe. The anther wall consists of an epidermis, an endothecial layer, a single wall layer and a glandular tapetum surrounding the sporogenous mass. The tapetum, at the mother cell stage, becomes amoeboid and invades the microsporangial cavity. The microspores are spherical, tricolpate and porate.

The unitegmic, tenuinucellate, anatropous ovule differentiates a single (rarely two) hypodermal archesporium which directly functions as the megaspore mother cell. The development of the embryo-sac is monosporic, Polygonum-type. The three antipodal nuclei are extremely ephemeral : a character shared by the Menyanthoideae. Fertilization is normal. The endosperm is free nuclear till the bi-celled stage of the pro-embryo.

The embryo development has been traced in detail and it corresponds with the Sagina variation of Caryephylloid type. This type of embryo development is found in the Menyanthoideae. It appears that in embryological features too, *Canscora* combines in it the characters of Gentianoideae as also of Menyanthoideae and hence the integrity of a single family Gentianoideae has been emphasized.

83. Studies in the Floral Anatomy of *Canscora diffusa* L.

RAMJI SHARMA, DHAR and S. R. UPADHYAY, Neemuch.

The tetramerous flower receives four calyx traces in pairs that soon divide into three each. Higher up, four traces to the corolla and another alternating four to the stamen depart to a common corolla tube. Later, the stamen traces trifurcate; the two laterals entering the corolla as corolla laterals, while the median one supplies the stamen. The two carpels receive only one dorsal trace each; the ventrals are apparently absent. The dorsals run through the whole length of the ovary and continue up in the style. In the ovary, horizontal branches of procambial nature are given off from the dorsals and these branches supply the placentae. Two collenchyma strands are seen running along the fused margins of the carpels, and these simulate fused ventrals. The parietal placentae arise as sub-marginal outgrowths and each bears anatropous ovules along three vertical rows. The fusion of corolla laterals with the staminal traces and the absence of ventrals point to a high degree of floral evolution in this species. The condition of fused corolla laterals with the staminal traces is found in the Menyanthoideae only and it is suggested that *Canscora* combines in it characters of Gentianoideae and Menyanthoideae both. Hence retention of a single family Gentianaceae has been advocated.

84. Foliar Sclereids of Dendropthoea falcata.

A. R. RAO and MANJU MALAVIYA, (MISS), Lucknow.

Although the occurrence and distribution of the foliar sclereids of this genus have been studied by Rao, T. A. and S. S. Kelkar (Journal of the University of Bombay, Vol. XX, part 3, November 1951), their ontogeny was not known. A study of the ontogenetic development of these sclereids is mentioned in this paper. The sclereids are transformed parenchyma cells which differentiate into sclereid initials mostly near the vascular bundles of the petiole. The differentiation gradually spreads into the lamina, towards the margin and the lower and upper epidermis. The sclereid initial may be solitary or in groups. They loose the cell contents, the wall becomes stratified and protrudes as a tubular or spiny growth in the surrounding intercellular space giving even the very young sclereid a stallate appearance. Further stratification of the wall is accompanied by pitting, the pits being thick, narrow and slit like. Further stratification closes these pores and the fully adult sclereid does not show any pores, and can be placed under the section Asterosclereid of Foster and also Esau. Generally there is a solitary crystal in the lumen of the adult sclereid, often embeded in the wall. The crystal disappears after heating it with NaOH. Further observations on these sclereids in the floral parts are in progress.

85. Embryology of *Lagotis glauca* Gaertn. (Selaginaceae).

M. A. RAU and V. K. SHARMA, Dehra Dun.

The family, Selaginaceae is as yet embryologically uninvestigated. Its systematic position and relationships are of interest since taxonomists have differed in their treatment of the family. Bentham and Hooker placed the Selagineae (including Globulariaceae) near the Verbenaceae. Engler and Prantl, while recognising the Globulariaceae as a separate family, treated the Selagineae as a tribe under the Scrophulariaceae. In recent years, Hutchinson has included the Selaginaceae in the order Lamiales.

Lagotis glauca, investigated here under a CSIR scheme on the morphology and embryology of some families and genera of disputed systematic position, is a herb found in the alpine zone of Western Himalayas. Material for study was collected from plants growing at an altitude of 4000 metres. The blue zygomorphic flowers are in dense spikes. The ovary is two locular with a single pendulous ovule in each locule. The ovules are anatropous, unitegmic and tenuinucellate. Megaspotogenesis results in a linear tetrad of megaspores. Development of embryosac is of Polygonum type. Endosperm is cellular and the micropylar and chalazal haustoria are weakly developed. Embryo development conforms to Onagrad type and is placed in the first group, fourth megarchetype of the first period in the system of classification of Soueges.

86. The floral anatomy of Woodfordia floribunda Salisb.

V. S. RAO, Bombay.

The vascular anatomy of the flowers of *Woodfordia floribunda* Salisb is studied. The floral tube is supplied by 12 bundles which arise at the same level. The androecium is supplied by 12 bundles which arise in positions opposite the perianth traces. Certain interesting features in the anatomy of the gynoecium are described.

87. Morphological differentiation of the section Sativa of the genus *Oryza*.

S. D. SHARMA and S. V. S. SHASTRY, New Delhi.

The present views on the phylesis of *Oryza* emphasize that *O. perennis* of the section Sativa is the most primitive species and that the other section, Officinalis and Granulata are of later origin. The morphological comparison of *O. perennis*, *O. spontanea, O. sativa* and *O. officinalis* indicate that for the chracters—breadth of the leaf, congestion of the branches on the panicle, number of secondary branches on the main branches and flattening of the caryopsis—*O. perennis* and *O. officinalis* occupy extreme positions. This could mean either that *O. officinalis* is a donor for introgression into *O. perennis* thereby leading to the origin of *O. sativa* or that a freely hybridizing pre-Sativa and pre-Officinalis group existed in the past which combined the characters of the species *O. perennis* and *O. officinalis* into what has subsequently evolved into *O. sativa.* The morphological date indicate that the role of *O. officinalis* in the origin of cultivated rices cannot be discarded, but needs further investigation.

88. Variation in length of vessel elements and libriform fibres within one tree Ulmus procera Salisb.

B. S. SIVA RAO and N. VIJAYALAKSHMI, Waltair.

In view of the comparative lack of definite information regarding the variation in length of the vertical elements of the secondary xylem in the individual angiosperm trees, variation in length of libriform fibres and vessel-elements was investigated in a ring porous Elm (*Ulmus procera* Salisb.) in successive growth rings from pith outwards, in specific growth rings from base upwards and between the early and late wood within one ring in the bole. Increase in length of these elements was noticed to be rapid at first and afterwards rather slow at any one level from pith outwards in the successive growth rings at four different levels in the bole. This increas in length was gradual nearer the base of the bole whereas it is abrupt higher up. In the specific growth rings there was a gradual increase in length of these elements from base upwards in the bole upto certain height after which the length decreased. The first-formed early wood elements of a growth ring are distinctly shorter than those of the last-formed elements. An abrupt fall in length of these elements was noticed in the transition from late wood of one ring to the early wood of the succeeding ring.

89. Embryo development of Mollugo L.

B. S. SIVA RAO, Waltair.

A detailed development of embryo has been studied in five species of *Mollugo* (*M. oppositihfolia* L., *M. nudicaulis* L., *M. ccrviana* Ser., *M. distichi* Ser., and *M. lotoides* O. Kze.). The first division of the zygote in transverse forming two superposed cells *ca* and *cb*. Cells *ca* and *cb* divide transversely giving rise to four cells *l, l', m* and *ci*. *l'* divides in a transverse plane giving rise to *ph* and *h*. *h* divides giving rise to *ha* and *hb*. The cells *m* and *ci* divide and give rise to a number of cells, *d, f, n, o* and *p* which form the suspensor.

The derivatives of the terminal cell of the two-celled proembryo contribute to the formation of the embryo proper while the suspensor is formed by those of the lower cell.

The formation of the embryo entirely from the derivatives of the two-celled proembryo, the presence of a hypophyseal initial and the formation of a linear suspensor which is not haustorial, key out to the Linum variation of Solanad type.

90. Structure of the secondary xylem of some dicotyledonous trees.

B. S. SIVA RAO, Waltair.

In view of the fact that wood from different parts of individual tree is extremely variable, an intensive rather than extensive study of the structure of secondary xylem has been undertaken in the bole, branch and root in oak (*Quercus robur L.*), *beech (Fagus Sylvatica* L.), sycomore (*Acer pseudoplatanus* L.), and robinia (*Robinia pseudoacacia* L.), Length variations of the vertical elements of wood (vesselelements, libriform fibres, fibre tracheids and tracheids), were studied from different positions of the same organ and from different organs in each of these trees. Histological features of the secondary xylem were studied in detail in respect of the ring and diffuse porous nature of the wood, size and structure of the vessel—elements the intervascular pitting, perforation plates, the nature and distribution of radial and vertical parenchyma. Differences in structure of the vertical elements of wood and the nature of variability in length of these elements in the boles, branches and roots in these trees, were brought out.

91. A contribution to the family Zygophyllaceae.
I. Development of male and female gametophytes of *Fagonia cretica* L.

R. D. SHUKLA, Udaipur.

The family Zygophyllaceae has received very little attention from the morphologists. Previous knowledge on the floral morphology of this family is not in a satisfactory state. Floral morphology and gametophytes of *Fagonia cretica* L. which is of common occurrence on rocky and hard soil in the State, flowering throughout the year, profusely after rains, have been described. Tricolpate pollen grains with smooth exine and intine are shed at tricelled stage. At unicelled stage it exhibits darkly stained chromatin like particles. There are two collateral obliquely anatropus ovules in each loculus. A well developed integumentary tapetum is present. Nucellus is scanty and ephemeral. A well developed lignified hypostase is differentiated. The development of the embryo sac is monosporic and its organisation conforms to that of Polygonum type. Further work on the other members of the family is in progress.

92. Structure and development of seeds in Euphorbiaceae : *Phyllanthus niruri* L.

R. P. SINGH, Agra.

The bitegmic ovule is nearly hemianatropous. The nucellus is massive; its knob-shaped beak extends beyond the integuments and comes in contact with the cells of obturator. The inner integument is generally three cell-layers thick while the outer integument is two cell-layered. The arrangement of the inner epidermal cells of the outer integument is very characteristic as the cells are arranged in two different patterns.

A hypostase is distinguishable at the base of the nucellus in post-fertilisation stages. It is composed of thick-walled cells and persists in a mature seed.

The seed-coat is formed by both the integuments. The cells of the outer epidermis of the outer integument elongate considerably during seed-development. In a mature seed they are arranged loosely and have a characteristic shape. The cells of the inner epidermis of this integument also persist in a mature seed and give a characteristic appearance under a stereoscopic binocular. The cells of the outer epidermis of the inner integument form the characteristic sclereid layer of the seed-coat. The embryo is of the Spatulate type and is slightly curved. The seeds of *Phyllanthus niruri* are excarunculate.

93. Structure and development of seeds in Euphorbiaceae : *Putranjiva roxburgh* Wall.

R. P. SINGH, Agra.

The superior ovary is generally trilocular. Each loculus possesses two collateral, pendulous and anatropous ovules. The nucellus at the time of fertilisation persists only as a column of cells at the base of the embryo sac. The inner integument, at this stage, is composed of 7 to 10 layers of cells. The cells of the inner epidermis of this integument are tapetum-like. The micropyle, except at the top, becomes imperceptible owing to the growth of the inner integument. The outer integument is composed of 4 to 7 layers of cell, but in the region of the raphe the number is larger. The vascular strands are present in this integument. These strands are the ramifications of the raphe bundle.

The development of the endosperm is of the free nuclear type and the endosperm ultimately becomes cellular. The mature embryo is of the Spatulate type. A hypostase is differentiated during seed-development. It consists of sclereids. The integumentary tapetum owing to divisions in various planes from a number of bulges at various places. These bulges face the embryo sac and majority of them are absorbed by the growing endosperm although, at places they are well-marked even in a mature seed.

The seed-coat is formed by both the integuments. The outer epidermal cells of the inner integument form the characteristic layer of the seed coat. The seeds of *Putranjiva roxburghii* are excarunculate.

94. Structure and development of seeds in Euphorbiaceae : *Bischofia javanica* Blume.

R. P. SINGH, Agra.

The superior ovary is generally trilocular. Each loculus has two collateral, pendulous and anatropous ovules. The micropyle is formed by both the integuments. The nucellus is massive and its small beak reaches the base of the narrowly enlongated endostome. The inner integument is 3 to 5 cell-layers thick. The outer integument is composed of 2 to 3 layers of cells but along the raphe and in the basal region the number is larger.

The development of the endosperm is of the Nuclear type. A hypostase differentiates at the base of the nucellus. Its cells become thick-walled and form a firm tissue at the basal region of a seed. A narrow zone of perisperm also persists above the hypostase.

The seed-coat is formed by both the integuments. The cells of the outer epidermis of the inner integument form a characteristic sclereid layer of the seed-coat. The other layers which persist are, the intermediary layer and the inner epidermis of the inner integument, and the outer and inner epidermal layers of the outer integument. The middly layer or layers of the outer integument are also discernible in a seed. The embryo is of the Spatulate type. The seeds of this plant are excarunculate.

95. Histochemical Studies on the Nectaries of *Sesamum indicum* L.

S. P. SINGH, Agra.

There are two laterally placed nectaries on the pedicel of the flower. On the basis of organogeny and the vasculate, the nectaries are found to be floral buds arrested in growth, and modified to serve the function of secretion. Histochemical studies were undertaken to determine the nature of secretion and a beginning was made with the test for the localization of acid phophatse in the nectaries. Nearly whole of the nectary showed a positive test for acid phosphatase. The second series of tests were for different types of sugars i.e. glucose, fructose and sucrose. Positive reactions were noticed for all the three and no difference in the distribution pattern of these could be observed. All these tests clearly show that secretion of nectaries consists of above mentioned sugars.

96. A study of style and stigma in relation to pollen tube growth.

I. K. VASIL and M. M. JOHRI, Delhi.

Morphology, anatomy and cytology of the transmitting tissue and the path of the pollen tubes in the style and stigma has been studied in seven plants. The pollen tubes grow through a well defined transmitting tissue and the course of their growth is predetermined. The number of carpels in a gynoecium determines the disposition of transmitting tissue.

Aegle marmelos, Fritillaria roylei and *Lilium tigrinum* possess a hollow style, while *Catesbaea spinosa, Nicandra physaloides, Pavonia zeylanica* and *Zephyranthes ajax* have solid styles. The stigmatic exudate in *Aegle* and *Pavonia* shows lipids.

In the bicarpellary gynoecium of *Catesbaea* there is a central, solid core of transmitting tissue. In *Nicandra* the gynoecium is either tetra-or pentacarpellary and the central solid core of transmitting tissue shows four or five radiating arms. In the solid styles the transmitting tissue becomes dissociated either at the time of pollination as in *Nicandra* or earlier as in *Pavonia* and *Zephyranthes*. The middle lamella seems to gelatinize followed by the development of intercellular spaces. The pollen tubes grow endotropically. In the ovary the pollen tube are generally transmitted ectotropically.

In the hollow styles of *Aegle, Fritillaria* and *Lilium* the pollen tubes grow along the papillate cells of the stylar caual. Pollen tubes in *Fritillaria* are conducted ectotropically in the style.

The stigmatic papillae and the cells of transmitting tissue in *Lilium tigrinum* become multinucleate due to amitosis and the nuclei fuse before pollination producing polyploid masses.

In *Catesbaca, Nicandra* and *Zephyranthes* maximum development of vascular bundle is observed in the stigma. In *Catesbasca spinosa* self-incompatibility is due to the inhibition of the growth of pollen tubes. Starch accumulates in the inhibited pollen tubes and this may be the cause or the result of incompatibility.

Intracarpellary pollen grains have been observed in *Fritillaria* and *Lilium*.

97. A contribution to the wood anatomy of Gyrocarpus.

J. VENKATESWARLU and C. BHASKARA RAMA SASTRY, Waltair.

A detailed anatomical study of the secondary xylem of the genus, *Gyrocarpus* collected from different parts of the world has been made. The xylem is characterised by the possession of several advanced features such as the presence of simple parforations, alternate intervessel pitting, homogeneous rays and vasicentric to aliform and confluent parenchyma. From these features it appears that *Gyrocarpus* shows affinity more with Lauraceae, Monimiaceae complex than with Combretaceae in which family it was included by Bentham and Hooker. *Gyrocarpus* with its essentially simple perforations of the vessel elements and homogeneous rays may be regarded as more specialised than th Lauraceous woods in which the perforations are scalariform to simple and the rays are heterogeneous. The genera *Hernandia* and *Gyrocarpous* share many important characters in common such as diffuse porous wood, solitary vessels, simple perforations, alternate intervascular pitting, paratracheal parenchyma and homogeneous rays. Therefore, on grounds of wood anatomy, the inclusion of these two genera in a single family seems justifiable.

98. A contribution to the wood anatomy of some Sonneratiaceae.

J. VENKATESWARLU and P. S. PRAKASA RAO, Waltair.

A comparative anatomical study of the woods of some members of Sonneratiaceae (*Sonneratia apetala* Ham., *Sonneratia acida* and *Duabanga sonneratioides* Ham.) was made and its bearing on the systematic status of the family discussed.

The woods studied are exclusively diffuse porous.

The woods of *Sonneratia apetala* Ham. and *S. acida* are characterized by (i) faint growth rings (ii) mostly solitary, evenly disposed, profusely tylosed, truncate, small to medium and orbicular to broadly oval vessel elements; perforations exclusively simple; inter-vessel pits numerous, typically vestured and predominantly alternate (iii) fibres medium-sized, semilibriform to libriform and mostly septate (iv) axial parrenchyma totally absent and lastly (v) almost exclusively uniseriate homogeneous rays with tanniferous and crystelliferous cells. The wood of *Duabanga sonneratioides* Ham. resembles those of *Sonneratia* except for thin-walled fibres, the presence of vasicentric to aliform parenchyma and weakly heterogeneous rays.

From this study it is evident that the woods display features both of primitive propensity and moderate phyletic advancement. A class comparison of the woods of Sonneratiaceae with those of related families apparently indicates that they have most features in common with Lythraceae, viz.—small to medium-sized vessels, numerous intervascular pits which are typically vestured, parenchyma exclusively paratracheal when present, rays mostly uniseriate and homogeneous to heterogeneous and fibres often septate and thin-walled to moderately thick-walled.

The above features indicate that the erection of Sonneratiaceae as a separate family does not rest on strong grounds, a conclusion also arrived at earlier on embryological grounds.

99. On the pollen of the Western Himalayan oaks.

VISHNU-MITTRE and GURDIP SINGH, Lucknow.

The pollen grains of 5 spp. of Western Himalayan oak viz., *Quercus semecarpifolia* Smith, *Q. dilatata* Lindl., *Q. incana* Roxb., *Q. ilex* L., *Q. glauca* Thunb. are so similar to one another that from their general morphological characters, it is hardly possible to distinguish these species from one another on the basis of their pollen grains.

The application of the statistical method to the data regarding the polar axis and the exine thickness collected from fifty random pollen grains of each species has helped in the segregation of five spp. into 2-3 groups, the individual members of each of which can be further separated from one another by their ecological incompatibility and distinct plant associations.

The importance of this statistical approach in tracing the history of the Oaks from the pollen-analytical investigations is also pointed out.

100. Studies of Indian pollen grains—I. Leguminosae.

VISHNU-MITTRE and B. D. SHARMA, Lucknow.

The paper deals with the pollen morphology of 326 spp. belonging to 102 genera of the family Leguminosae distributed in India. Based on the characters of apertures and the exine pattern, 67 pollen types have been recognised. More than two pollen types have been noted in the genera *Bauhinia* (10), *Acacia* (6), *Indigofera, Millettia* and *Sesbania* 4 each and in *Crotalaria* and *Erythrina* 3 each. Several other large genera such as *Cassia, Astragulus, Tephrosia, Desmodium* and *Phaseolus* are either stenopalynous or are characterised by only two pollen types.

Besides the Colpate, Colporate and porate grains already known in this family, inaperturate and spiraperturate grains have also been found. The porate grains which have so far been encountered exclusively in Phaseoleae, have also been found in the Tribe Galegeae (genus *Psoralea*).

An attempt is also made towards the application of pollen morphology to the Taxonomy of the Indian Leguminosae. Despite some encouraging results as for instance in the subdivision of the tribes Trifolieae and Eucaesulpinoideae where the pollen morphology has been found to be in accord with the taxonomy, the utility of pollen morphology in the taxonomy of the family, on the whole, is very much limited.

PHYSIOLOGY

101. On the effect of sound waves on the Respiration of flower buds of *Hamelai patens* Linn.

K. BALAKRISHNAN, Annamalainagar.

In the present investigation experiments were conducted on the effect of sound waves on the respiration of flower buds for the first time. Young flower buds of *Hamelia patens* Linn. were carefully selected out. After pairing them into two lots the volume was determined by the method of displacement of water. The volume was maintained precisely as 4 cc. for both the experimental and control flower buds. The experimental set was excited with the sound waves of an electric buzzer for a period of 25 minutes. Ganong's Respiroscope was used to find out the respiration value volumetrically in these experiments. It was observed that the second excited flower buds showed a higher respiration value than the control. The results were analysed statistically and have been found to be significant in favour of the sound excited flower buds at both 5% and 1% levels.

102. Amino Acid Metabolism in *Phaseolus radiatus* plants under conditions of Reduced Water Uptake.

D. BANERJI and M. M. LALORAYA, Allahabad.

Experiments carried out in this laboratory have shown large accumulation of Arginine and Asparagine in plants subjected to mineral deficiencies. From the freshweight ratio of 6 : 1 of control and experimental plants the growth inhibition could be attributed mainly to decreased water uptake. To pinpoint whether the aforesaid increment in Arginine and Asparagine levels is due to special properties associated with mineral uptake or to reduced water uptake or both, the following experments were performed.

Experimental plants were grown in Arnon and Hoagland's nutrient solution with high osmotic concentrations, viz., 0·5M, 0·25M and 0·1M of Mannitol added to reduce water uptake. Controls were kept in nutrient solution only.

Plants in 0·5M and 0·25M wilted and subsequently dried in 2—3 days whereas the growth of those in 0·1M Mannitol stopped.

Amino acid extracts from roots and stems of controls and 0·1M experimentals were subjected to two-dimensional chromatography.

The plants in 0·1M Mannitol showed much larger accumulation of Asparagine and a moderate increase in the Arginine content as compared to the controls. There was, however, a general increase of other amino acids present in the pool.

From the above results Asparagine accumulation can be attributed to reduced water uptake presumably caused by mineral deficiency and that of Arginine due probably to some mineral effect.

103. Physiological studies on salt-tolerance in crop plants.

S. N. BHARDWAJ, Agra.

In the present study, the effect of sodium Carbonate, added to the soil at 0·01% and 0·03% cocentrations, on growth and maturity of wheat and gram was investigated under pot cultures. The results indicate that the presence of the salt even in 0·03% concentration (on air dry soil) was definetely deleterious to growth of the two crops. Under favourable water supply, the crop differences in relation to their tolerance to the carbonate were not clear; with soil-droughts at the stage of vigorus plant growth (9th to 12th week after sowing), gram was less susceptible than wheat; later droughts at the maturity stage (13th to 16th week), resulted in greater depression in gram than wheat. The toxic effect was apparent from chlorosis, tip burn and premature drying of the leaves in the 'carbonate' series.

Experiment to induce tollerance to Na_2Co_3 by pretreating the seeds failed to indicate promising results. Under favourable water supply, these treatments were definitely harmful; with soil-droughts at the maturity stage, continuous soaking of seeds in carbonate solution was apparently beneficial to gram.

104. Studies on growth behaviour of sal (Shorea robusta) seedlings in different soils (soil culture).

H. P. BHATNAGAR, Dehra Dun.

Soil culture experiment was conducted with a view to compare the results of sand culture experiment, to determine if there is any deficiency of mineral constituents in the sal soils and also to determine desirable soil properties for securing good sal regeneration, and the relation of comparative growth data to the status, good or deficient, of sal regeneration in the localities from which the samples are derived.

The study revealed that the North Kheri good regeneration area soil is significantly superior to all the others in all characters except leaf area and even in this regard it shows the maximum development. This soil derived from first quality area under *Sal-Terminalia-Moghania* community. Therefore not only is the soil good for securing regeneration but the initial growth of the seedlings is rapid and the subsequent development of the crop is also excellent.

Within the range of this study then this soil may be taken as the ideal from the point of view of sal, and other soils may be rated accordingly as they approximate to or depart from this soil in various properties.

All the soils originating from deficient regeneration areas are inferior to those originating from good regeneration areas, except for Bahraich soil from good regeneration area.

The comparison of the results of soil and sand culture experiment with regard to chemical analysis indicated clearly that with regards to Nitrogen, Phosphorus and Potassium there is no deficiency of these minerals in the soils studies. On the other hand a critical examination of all the soil determinations, i.e., mechanical physical and physico-chemical reveals that of the 14 characters, only soil pH, soil moisture in situ, water holding capacity, moisture equivalent and organic matter show indications of a definite relation to growth rate. The range of dispersion of pH values is small and much reliance cannot be placed on moisture in situ which is extremely dependent upon climatic conditions and therefore these two factors cannot be used as a basis for classifying soils with reference to development of sal seedlings.

105. Interaction of gibberellic acid and growth regulating substances of the root extract of water hyacinth (*Eichhornia speciosa* Kunth.) on the growth and flowering behaviour of rice (*Oryza sativa* var. *Chinsurah Boro I*) and gram (*Cicer arietinum* Var. *N. P. 58.*)

ROTHIN CHAKRAVERTY and S. M. SIRCAR, (Calcutta).

Interaction of gibberellic acid (GA) with growth regulating substances of the root extract (RWH) of water hyacinth (*Eichhornia speciosa* Kunth.) on the growth and flowering behaviour of a summer paddy (*Chinsurah Boro I*) and gram (*N.P.58.*) was investigated. The treatments consisted of 100 ppm. GA, root extract ot water hyacinth in the conc. of 1 :5 and 100 ppm. GA plus the root extract mixed in the proportion of 1 :1 (GA+RWH). The spraying commenced with 40 days old seedlings and continued once a week till the time of flowering. All the treatments resulted in an increased height in both rice and gram plants. Death of the apical meristem after GA treatment in the gram plants was noted. GA further decreased tillering in rice and lateral branches in gram, while RWH and GA+RWH increased their growth to a great extent. All the treatments induced flowering earlier than the control and the maximum earliness was noted with plants treated with GA. Although GA increased the length of the spike but it was associated with a low percentage of grain formation and the grain yield per plant was greatly reduced. Between the treatments, RWH showed the best effect as the quantity and percentage of grain was greater than with other treatments.

106. Studies in transpiration in relation to sound—*Hurv crepitans* Linn.

VINCENT DANIEL, Annamalainagar.

The only experiment so far done on transpiration in relation to sound waves has been on *Bauhinia tomentosa* Linn. In the present investigation an Euphorbaceous plant *Hura crepitans* has been experimented upon. It has got a simple leaf with fortunately a very long petiole. The leaves were placed in water contained in a small bottle and a layer of coconut oil was floated on the surface of water to check surface evaporation. The specimens so prepared were subjected daily to excitation by sound waves emitted out of a tuning fork of 92 frequency for a period of half-an-hour (8-30 A.M. to 9-00 A.M.). Thereafter the excited leaves were placed in a common place along with control leaves. The loss of water was determined gravimetrically by weighting the experimental and control leaves before and after the close of the experiment.

Twenty-two experiments have been done so far and in each of them it was found that the excited leaves definitely registered a higher transpiration values to the highest extent of 200% as compared to the control. There was no doubt variation in the values but these have been correlated with the temperature and humidity of the day. The results so far obtained have been analysed statistically and have been found to be significant at both 5% and 1% levels.

The results obtained fully confirm the results of Professor Singh on *Bauhinia tomentosa* L.

107. Pollen and pollen tube studies of Morus in vitro.

B. C. DAS, (West Bengal).

In course of interspecific hybridization at Central Sericultural Research Station, Berhampore (W. Bengal) studies were made in vitro on pollens and pollen tubes of several species of *Morus* with a view to investigate how far such observations can be correlated to the data obtained from interspecific crosses.

The pollens of *Morus indica* L. var. laciniata (2n=28), *M. alba* L. var. Vishnupur (2n=28), *M. alba* L. var. Maldah (2n=28), *M. alba* L. var. China White (2n=28), *M. alba* L. var. Peking (2n=28), *M. multicaulis seringe* (2n=28) and *M. latifolia* Koidz (2n=28) are round and smooth, while those of *M. alba* L. var. Okinava (2n=28) and *M. laevigata* Wall (2n=56) generally are round, occasionally oblong or oval. In most species the average diameter of pollens varies from 12—25μ while the maximum diameter is 35μ in *M. laevigata* Wall.

The number of germ pores per pollen varies from 2—3 in most species, in a few cases they are found to be 5. Generally one or two pollen tubes grow from each pollen. The pollen tubes are unbranched in all the species except M. alba var. Peking in which the tube is bifurcated.

The percentage of pollen germination varies from 55—88 in most species while in M. laevigata Wall, it is as low as 15. The high sterility of pollens in M. laevigata Wall, it is as low as 15. The high sterility of pollens in M. laevigata Wall. may be due to its polyploid nature.

108. Interaction of light and external application of auxin on growth of rice seedlings.

T. M. DAS and J. M. CHOUDHURI, Calcutta.

Soaked grains of rice Var. *Rupsail* were allowed to grow for 120 hours in different concentrations of IAA (0·1 ppm, 0·01 ppm, 0·001 ppm) and under following treatments of light. (1) Continuous dark, (2) 1 minute light in 24 hrs. of darkness, (3) 1 minute dark in 24 hrs of light, (4) continuous light. The intensity of light was 125 f.c. and temperature was 29·8 c.

From the result it is evident that on application of IAA mesocotyl growth was accelerated in Continuous darkness upto 28% to 50%. However, one minute exposure to light, in every 24 hrs. of darkness completely suppressed the mesocotyl growth at all the concentrations including control. It is thus evident that presence of auxin at any of these concentrations was not enough to nullify the inhibitory action of light in mesocotyl growth.

In the case of root at higher concentration of IAA a significant inhibition of growth in length was found. It is interesting to note that under continuous light the total dry weight of the root was greater than that found under continuous darkness in all concentrations of IAA including control. Such acceleration of dry weight of root under continuous light was chiefly because of the increased number of rootlets. It is also noted that only one minute exposure to light at every 24 hrs. of darkness is quite sufficient for considerable increase of dry weight of root as compared to that of continuous darkness.

109. Studies on the growth of rice tissue under submerged condition. I. The effect 2, 4-dichlorophenoxyacetic acid on exised segments of coleoptiles under

T. M. DAS and A. K. MUKHERJEE, Calcutta.

Coleoptile segments of rice were cultured under submerged condition as well as under floating condition. On application of 2,4-D a sharp and significant increase in growth in elongation was recorded.

At higher concentrations e.g., 100 and 10 ppm the growth rate was higher in floating segments of coleoptiles. But at lower concentrations, including control, the growth rate was higher in submerged ones, which apparently indicates that the optimum concentration of 2,4-D for growth of rice coleoptile is shifted with shifting of oxygen tension. Three different mutually opposing factors namely, lowered auxin destruction under submergence, concentration of auxin in the plant tissue and lowered aerobic respiration have been stated to be responsible for growth of rice tissue under water.

110. Effect of different sugars on the growth of pollen tubes of *Corchorus siliquosus* L., a willd jute of America.

R. M. DATTA and B. S. PANDA, Calcutta.

Pollen grains were cultured on 8% lactose gelatin agar and 4% sucrose gelatin agar. Measurements were taken on two days in the months of November and December, 1960. In this wild jute species 8% lactose gelatin agar was found stimulating, where maximum pollen tube growth of 947·28 μ was recorded.

111. Effect of Boron on the induction of rooting in case of hormone treated materials.

A. S. DUBEY, Patna.

The present work is in continuation of the author's previous report that the micronutrient Boron induces earliness in roting the normone treated *Myrtus* stem cuttings. It has now been confirmed in case of stem cuttings of *Hibiscus rosa sinensis* L. and isolated leaves of *Porana paniculata* Roxb. and *Celosia cristata* Linn. Stem cuttings of Hibiscus were treated with 100 p.p.m whereas the isolated leaves of *Porana* and *Celosia* were treated with 20 p.p.m. I.B.A. for 24 hours. Then they were washed thoroughly and kept in water in the rooting chamber, i.e. in diffused light and in humid conditions. Water was changed daily in all the cases. After callus formation, Boron was sprayed over the leaves in the form of moric acid in very low concentrations, i.e. 10 p.p.m. It was observed in all the cases that healthy roots came out earlier than in the control sets, i.e. only hormone treated ones.

112. Effect of Gibberellic Acid Like Substances on the Growth Elongation of Mustard T. 102 Seedling Hypocotyls.

GYANENDRA VERMA and D. K. VERMA, Almora.

Gibberellic acid like substances were isolated from (A) shells of green pods of *Clitorea ternatea*, (B) flowers of *Cuscuta* and (C) fresh sprouts of Potato var. Uptodate. 1 in 10 water extracts containing gibberellic acid like substances were prepared by methods described earlier (Verma, D.K., Proc. 48th Ind. Sci. Cong. III, p. 323, 1961).

Optimum concentrations of these extracts which induced maximum growth elongation of mustard T. 102 seedling hypocotyls were found to be 1/100 for (A), 1/1000 for (B), 1/100 for (C). Comparison of these extracts with glass distilled water and with the optimum concentrations of similar extracts of (D) immature seeds of *Clitorea ternatea* and (E) tender vines of *Cuscuta* showed that the best elongation of both hypocotyls and roots of mustard T. 102 seedlings was given by 1/100,000 extract of (E), followed by 1/50,000 extract of (D), followed by (A), (B) and (C). Extracts of shells of green pods of *Clitorea*, or *Cuscuta* flowers and of Potato sprouts induced similar growth elongation of seedling hypocotyl. Except for (A) which induced root length similar to control (GDW) all the extracts stimulated better root length than GDW. All the extracts induced better hypocotyl growth than GDW.

This work was carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

113. Effect of Water Extracts of Fertilised Gynoecia of Garden Pea on Growth Elongation of Pollen Tubes.

GYANENDRA VERMA and D. K. VERMA, Almora, U.P.

Effects of water extracts of gynoëcia of Garden pea (*Pisum sativum*) var. English Wonder flowers collected (A) before pollination and (B) 24 hours, (C) 48 hours and (D) 72 hours after pollination on the growth elongation of garden pea pollen tubes, were observed.

Optimum concentrations of these extracts which in control medium (12·5% sucrose solution + 1% agar) induced maximum elongation of garden pea pollen tubes were found to be A/200, B/300, C/200 and D/100. Compared to the growth elongation of 360 microns in 6 hours in control medium that induced by the four extracts at 1 :200 level were A/200 508 microns, B/200 624 microns, C/200 520 microns and D/200 384 microns, while the lengths of pollen tubes induced by their obptimum concentrations were A/200—508 microns, B/300-746 microns, C/200-520 microns and D/100-466 microns.

Estimations of amino-acids and sugars, present in the gynoecia at each stage were made by chromatographic technique. In all, 10 spots of amino-acid groups were obtained. Areas of spots of amino-acids, in general, increased to a maximum in the chromatograms of B and then gradually declined in those of C & D. Ornithine, D1-2-aminobutyric acid and isoleucine-leucine were maximum in A and gradually decreased in B, C and D, Ornithine being absent in C and D. Lysine-Histidine were not present in A, but appeared in B and gradually declined in C and D. Citrulline, Glutamic acid-aspartic acid-threonine were highest in B and decreased thereafter. Arginine-Serine-Glycine-Tarusine-Creatine were highest in C and decreased thereaftr. Except methionine-valine the areas of the different amino acid groups were smaller in D than in A.

Only one spot of sugars was developed in chromatograms of A and B, the area being 80 and 85 sq. mm. respectively. In chromatograms of C and D no sugars were detected.

These results show that amino-acids and sugars (and possibly other growth regulators) increase rapidly during the first 24 hours after pollination and then decrease progressively, as is also shown by the growth elongation of pollen tubes induced by different extracts.

There studies were carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

114. Studies in the Phosphorus Fractionation in some edible leaves of plants grown in Bombay and its Suburbs—Part III.

SMT. KARKAL, MALINI, and B. S. NAVALKAR, Bombay.

The investigation on phosphorus content was carried out on some edible leafy vegetables of every day use in Bombay. In this third series the plants analysed were *Raphanus sativus*, L. (Mula, radish), *Trigonella foenum*, Graecum. (methi, Fenugreek), *Moringa oleifera*, Lam. (Shevga, drumstick), *Allium cepa*, L. (Kanda, pyas, onion), *Colocosia antiquorum,* Schott. (Alu-black, elephant's ear), *Portulaca oleracea*, L. (Gnol), purslane), and *Basella alba*, I. (Mayali, indian spinach).

Nitric-perchloric acid digestion as recommended by Hardin et. al. was used for Total Phosphorus determination. Acid-soluble phosphorus was extracted in 10% Trichloroacetic acid and digested with nitric acid. Lipid phosphorus was extracted with ether-ethanol mixture. Inorganic phosphorus was extracted with Trichloroacetic acid and this extract was used directly. The phosphorus content was determined colorimetrically by using phctoelectric colorimeter, according to A.O.A.C. procedure.

All plants were collected from the same locality to minimize the difference in environmental factors. The results show that the plants are sufficiently rich in their phosphorus contents (124·35—871·64 mgm/100 gm), and could be ordinarily used even by economically lower groups in society to keep up the nutritive balance of phosphorus in their every day diet. The moisture content is sufficiently high (75·79—90·40%), except in Moringa oleifera (30·68%). Further the conclusions drawn from the laboratory tests can serve only as rough guide.

115. A note on the effect of Gibberellic Acid on two forage plants : *Sorghum sudanense* and *Trijolium alexandrianum.*

SUDHIR KUMAR and D. GUPTA, Jobner (Rajasthan).

The effect of Gibberellic Acid has been studied on the growth yield and root development in *Sorghum sudanense* and *Trifolium alexendrianum.* Plants were sprayed with three different concentrations of G.A. viz. 200 ppm, 100 ppm ad 50 ppm. The results indicate that plants sprayed with G.A. show increase in yield and growth. At 200 ppm it was observed that root development was inhibited.

116. A note on the mechanism of Auxin action.

M. M. LALORAYA, Allahabad.

The presence of a strong negatively charged group at an unobstructed distance of 5·5 Å units from a weak positively charged group in the auxin molecule coincides well with the distance involved in the formation of hydrogen bonds between the –CO.NH group which hold the peptide chain in the α-helix structure of the protein and between the hetero-polar bonds in the wall material. Models based on the interactions of bonds and the charges in the auxin molecule and that in the protein and wall structure, have been proposed to explain the mechanism of auxin action in plants. The diverse observed effects of auxin have been explained in terms of the two models.

117. Effect of Gibberellic Acid on Rice.

G. MISRA and G. SAHU, Cuttack.

The effects of Gibberellic acid (GA) on the growth and development of two varieteies of rice, one early, N.136 and the other later J.192, have been studied. The treatment consisted of soaking the grains separately with 1, 10, 100 and 500 parts per million (ppm) of GA for 72 hours and the subjecting the plants thus obtained to weekly foliar spray with the same concentration of the chemical with which the grains were initially soaked. GA brought about a significant earliness in flowering at lower concentrations, whereas at the highest concentration of 500 ppm an opposite effect, namely delay in flowering was observed in both varieties. With regard to certain aspects of vegetative growth such as the production of tillers and leaves, the chemical had an inhibitory effect particularly at the high concentrations of 100 and 500 ppm and that, too, more prominently in the late variety of rice. As is very characteristic with the chemical it brought about a marked increase in height of the treated plants, the maximum increase being observed at 500 ppm, the highest concentration used. The other outstanding result is a significant increase up to a maximum of 25% in the yield of grains from plants treated with the two lower concentrations of 1 and 10 ppm of the chemical. The higher yield was mainly due to the formation of greater number of panicles in the treated plants in comparison with the untreated controls.

118. Effect of Maleic Hydrazide on Rice.

G. MISRA and G. SAHU, Cuttack.

The response of two different varieties of rice, N.136 (early) and J.192 (late) to the treatment of various concentrations of Maleic Hydrazide (MH) was studied. The treatment consisted of soaking the grains prior to sowing for 72 hours separately with 1, 10, 100 and 500 parts per million (ppm) of MH followed by a post-sowing foliar spray with the same concentration of the chemical with which the grains were initially soaked. The spray commenced with 28-day-old seedlings and was continued till the time of ear emergence. The grains soaked with 500 ppm of MH germinated alright ubt the seedlings did not grow any further. Hence no data could be collected from this set. With regard to the rest of the treated sets a slight but significant earliness in ear emergence was observed at the lowest concentration of 1 ppm more particularly in the early variety and the opposite effect i.e., delay in ear emergence at the concentration of 100 ppm in both the varieties. The vegetative growth as reflected by the production of tillers and leaves, though, showed a decrease in the early stages mainly in the late variety, on the average was not markedly changed at the mature stage from that of the untreated controls but there was a distinct increase in height in both the varieties under the influence of the lowest concentration of 1 ppm. The grain yield of the treated plants did not significantly vary from that of the controls.

119. Effect of Plant Growth Substances on Rice.

G. MISRA, Cuttack and D. MISHRA, Sambalpur

The effect of three plant growth substances, IAA, NAA and TIBA at 1, 10 and 100 parts per million (ppm) upon the growth and reproduction of four varieties of rice, N. 136 (early), T. 1145 (early-winter), T. 141 (mid-winter) and J. 192 (Late-winter) has been studied. The treatment consisted of a preliminary seed saoking for 72 hours followed by a weekly foliar spray, beginning at the week and continuing until ear emergence. IAA produced a significant earliness in ear emergence in the early, mid-winter and late-winter varieties. NAA had no effect on early and early-winter varieties but produced a significant earliness in the mid-winter and late-winter varieties. TIBA had but little effect on early and early-winter varieties and produced a significant earliness in the mid-winter and late-winter varieties. Thus the three growth substances bring about different results even in the same variety of rice and also the different varieties respond variously even to the same growth substance. With regard to grain yield it wos seen that IAA at 100 ppm. brought about a higher grain yield in the early, early-winter and late-winter varieties. TIBA also increased the yield of the early variety at 100 ppm and the early-winter variety at 1 and 10 ppm and that of the mid-winter variety at the three concentrations used. NAA had a depressing effect on yield particularly in the early-winter and mid-winter varieties.

120. Estimation of Absolute Stomatal Numbers in Ipomoea Carnea Jacq. growing in two different habitats.

PRASANNA KUMAR MOHANTY, Sambalpur.

There is no conclusive evidence as yet if the environmental conditions influence the frequency of stomatal number. The leaves of two healthy branches of two plants of the species *IPOMOEA CARNEA*, Jacq; were selected and five leaves from, each branch were plucked, begining from the first unfolded leaf, and were serially numbered. Then the area of each of the leaves was determined. Then the upper and lower epidermises were separated in the manner of Gupta (1960) by the treatment of concentrated colourles Nitric acid. Stomata were counted under the microscope, whose field of focus was previously standardized.

The average number of stomata per unit area was then calculated and the total stomatal number or "Absolute Stomatal Number" was obtained by multiplying this value with the total leaf area.

A graded difference was observed in the average stomatal number per unit area in two corresponding leaves. Their total stomatal number per leaf-lamina is seen to be more or less constant. This value is constant in matured leaves only. In this particular species, the difference in stomatal nnmber per unit area in both the epidermes is not very sharp.

121. A preliminary study in the variation of water and dry matter in the leaves owing to a change in habitats.

S. NAIK and P. K. MOHANTY, Sambalpur.

It is well known fact that the habitat exerts certain influence on the growth of plants. The present paper aims at determining the total dry matter in the first five leaves of a commonly occuring plant *Ipomoea carnea*, growing at Sambalpur in marshy (semi aquatic) and in ponds (aquatic). Leaves from first 5 nodes of plants growing in water (nearly 3ft-deep water) as well as plants growing in a marshy community were detached. As many as 15 to 20 healthy leaves were selected from each nde. The petioles were cut off from the base of the lamina, and each sample was weighed. A number of circular discs were cut with a punch and the number of discs in a weighed sub sample was counted. These discs were dried in an even at 100° at 1000 mm of Hg.

The areat per unit weight of lamina was calculated from (a) the number of discs (b) the known area per disc and (c) the fresh weight of the sample. It was then multiplied with fresh weight of lamina and divided by the number of leaves to give the average leaf area.

It was observed that although *Ipomoca carnea* growing in water have got on the average a reduced leaf surface compared the corresponding leaves of the same semi aquatic plant, but there is no remarkable difference in the production of dry matter. This is more evident in matured leaves. The percentage of loss of water on the average in the aquatic and semi aquatic leaves was found to be 69·0 and 74·5 respectively.

122. Exposure of Sesamum orientale L. to Chronic Gamma Irradiation—its response to flowering and growth.

G. G. NAIR, Bose Institute, Calcutta.

Sesamum orientale L. var *T 16* (West Bengal) plants were grown in concentric rows around a cobalt 60 gamma irradiation field source, with an initial activity of 14·85 curie. The plants were exposed to irradiation for about 17 hours a day, from sowing upto the time when all plants completed flowering. These plants were compared to the control plants grown outside the effective area of the gamma source. The irradiated plants showed earliness in flowering from two to six days and also stimulated growth and increased number of branches as against the control. The plants that were grown under highest dose rate (41,401·0 mr. per day) i.e. nearest to the source had minimum stimulation in flowering and vegetative habit and approached the condition in the control, as compared to other lower doses (4,599·1 mr; 1,656·1 mr; 845·2 mr; 511·3 mr; 342·9 mr; 245·8 mr; 184·0 mr. and 115·4 mr. per day) where significant difference in mean heights and mean number of branches were observed.

123. On the effect of sound waves on the growth of sugarcane.

S. PANNIRSELVAM and P. SANKARANARAYANAN, Annamalainagar.

In the present investigation, sugarcane variety CO.527 was subjected daily to the sound waves of an electrically run tuning fork, for a period of exactly half-an-hour in a nursery 16 feet × 8 feet located in the University Botanic Garden. Besides, a control plot of the same dimension, having the soil of same texture and constitution, with the very same sugarcane variety grown in it, was also maintained. Observations were periodically made on germination, tillering, thickness of the mother cane and length and breadth of leaf.

After a total period of eleven months, the cumulative effect of the sound waves are now very clearly visible, namely there is a great difference in height measurement and thickness of the stem, tillering and size of the leaf. In each of these obserrvations, the excited plants expressed higher values than the control. The results have been statistically computed and have been found to be highly significant, at both 5% and 1% levels.

These results are in full agreement and confirmation of the results obtained by Professor Singh (1960) in respect of two sugarcane varieties namely a thick chewing variety and another sugarcane variety CO.719.

124. Regulation of Hypocotyl growth in epigeal seedlings.

V. K. RAI and M. M. LALORAYA, Allahabad.

The regulation of hypocotyl growth in two distinct types of epigeal seedlings—one in which the cotyledons act only as an organ of storage and falls off during the growth of the seedlings (type I) as compared to the other in which case the cotyledons expand and grow and take the function of the first primary leaves (type II) has been studied.

It has been shown that while 100 ppm of IBA inhibits hypocotyl growth in type I seedlings (*Phaseolus mungo*) and that this inhibition is reversed by 5 ppm of GA 3; in type II (*Luffa aegyptiaca*) the inhibition of the hypocotyl growth is reversed at the cotyledonary leaves start growing i.e. after 3rd day in light. That this reversal is chiefly due to the growth of the cotyledonary leaves in light is borne out by the fact that seedlings grown in dark continue to exhibit a marked reduction in the growth of hypocotyl as compared to control.

In the epigeally growing Tamarind seedlings two new gibberellins have been detected which react to permanganate test and fluorescence in presence of H_2SO_4 in ultra violet light. GA 3 alone is known to give this fluorescence and co-chromatographing with GA 3 although showed similar fluorescence, these gibberellins had lowered Rf values as compared to GA 3. The gibberellins in Tamarind are thus close to the GA 3.

It is suggested that interaction of auxin and gibberellin is in control of the hypocotyl growth.

125. Studies on the effect of different concentrations of Sodium Chloride and Sodium Carbonate in nutrient solutions on growth of groundnut (Var. TMV 4) in sand cultures.

G. RAJESWARA RAO and I. M. RAO, Tirupati.

The tolerance of groundnut plants (variety TMV 4) to a treatment of Sodium Chloride and Sodium Carbonate as studied. The plants were raised in pots filled with river sand. The plants received besides culture solution 0·2% and 0·8% NaCl solution in one set and 0·1% and 0·2% Na_2CO_3 solution in another set. The solutions were added daily and every third day during the first 30 and next 30 days respectively. One control series receiving only nutrient solution was also maintained.

The plants were thinned out at the end of 30 and 60 days after sowing and the oven dry weight of the shoot was determined. The average dry weight of shoot per plant in each treatment was calculated as percentages on control for the treated plants. Compared to the controls, plants treated with 0·2% NaCl showed a marked decrease with age in shoot dry weight (the reduction being 5·3% and 21·4% for the 30 and 60 day old plants.) whereas with 0·8% the decrease is slightly accentuated at both stages of growth.

With 0·1% Na_2CO_3 the reduction in shoot weight is much less (the reduction being 2% and 4·5% at 30 and 60 day old plants respectively. However, with 0·2% treatments the corresponding reductions at the two stages are 17% and 20%. Thus groundnut plants seem to be susceptible like other legumes (e.g., gram) to soil salinity and alkalinity.

Investigations are in progress to find out the effect of NaCl and Na_2CO_3 on yield and growth characters of groundnut.

126. Observations on the effect of sound waves on the stomatal frequency and index of *Urginea indica* Kunth.

K. RANGASWAMI AYYANGAR, Annamalinagar.

Previous reports in this laboratory have shown that sound waves produced by the tuning fork have the effect of increasing the rates of vital processes of plants, like carbon assimilation, respiration and transpiration. It is common knowledge that the stomata play a significant role in the regulation of physiological processes, and so the present undertaking was intended to see how far these stomata are affected by the sound waves. For this purpose, bulbs of *Urginea indica* Kunth., the Indian Squill, were planted in a plot of ground in concentric circles in the centre of which an electrically run (Cenco, U.S.A.) tuning fork (of 92 frequency) was placed. The tuning fork was switched on for 30 minutes every day at 6 A.M. The blubs were so disposed, that no bulb was more than 3 feet distant from the tuning fork. Another plot was chosen far away from the previous one, where also bulbs of *Urginea indica* Kunth., were planted. Care was taken to see that the size and number of bulbs and the pattern of their planting as also the nature of the soil were identical in both the plots. Epidermal peals from the lower and upper surfaces of mature leaves of the control and experimental plants were examined and stomatal counts were made. From the counts so made, stomatal indices were also calculated. Statistical comparisions were made between the stomatal indices of the lower and upper epidermises of the control and experimental plants. From these studies, it became evident that the stomatal frequency per unit area in the lower epidermis of the sound-treated plant was 45% greater than that of the control. In respect of the upper epidermis, it is 27% more in the experimental than in the control. Furthermore, the stomatal indices of the lower and upper epidermises of the experimental plant were far higher than those of the control and in fact the higher values of stomatal index registered by the experimental in contrast with the control have been found to be statistically significant.

As is well known, the stomata play a strategic role in the excanges of gases and moisture between the mesophyll of the leaf and the external atmosphere and naturally any change in them is bound to exercise profound influence upon physiological processes like photosynthesis, respiration, transpiration, growth and reproduction. Therefore, changes in the stomatal frequency brought about by sound waves impinging on the leaves, afford a scientific basis for the higher rates of vital processes observed by the previous workers.

127. Studies in the activation of carbon assimilation of *Aponogeton monostachyon* Linn. by sound waves.

N. C. RATHAKRISHNAN, Annamalainagar.

Recently it has been shown by Professor Singh and his collaborators that sound waves have an activating effect on the carbon assimilation of hydrophytic angiospermic plants like *Hydrilla verticillata* Presl., *Lagarosiphon roxburghii* Benth., *Vallisneria spiralis* Linn., *Ceratophyllum* and others. These experiments have in consequence been extended in this investigation to *Aponogeton monostachyon* Linn. It is a submerged aquatic angiospermic plant which grows very plentifully in the University boating canal with a view to investigate as to how far the results from it could confirm previous findings.

Experiments were conducted with all the meticulous care and control as in previous experiments. As a result of 24 experiments, it has been observed that the quantum of carbon assimilation as judged from the evolution of Oxygen in the experimental sets excited by sound waves, is far superior to those of the control sets not excited by sound waves.

The resultant data of all the 24 experiments were subjected to statistical analysis and they have been found to be very highly significant at both 5% and 1% levels by Fisherian 't' test. This therefore further confirms the previous findings showing thereby the great extent sound waves affect carbon assimiliation.

128. Studies on isolated plant nuclei. I. Tracer studies on nucleic acid metabolism in coconut milk.

R. ROYCHOUDHURY and S. P. SEN, Bose Institute, Calcutta.

The metabolic interrelationship of DNA and RNA is a matter of considerable interest. Coconut milk with its ree endosperm nuclei has been found to be a very suitable material for such a study since the nuclei and 'cytoplasmic fraction' can be easily separated by centrifugation. Intact green coconut was injected with radiophosphorus and after 18-20 hrs. of incubation P^{32}—labelled nuclei and cytoplasmic fractions were separated. A similar unlabelled preparation was obtained from another coconut which did not receive any P^{32}. Labelled nuclei was then incubated with unlabelled 'cytoplasm' and labelled cytoplasm with unlabelled nuclei. After incubation the DNP from the nuclei and RNP from the cytoplasmic fraction were isolated. It was observed that labelled nuclei had transferred P^{32} to the unlabelled cytoplasmic RNP and *vice versa*. Both DNP and RNP were hydrolysed and paper chromatographic separation of the products revealed the presence of P^{32} in some of the nucleotides of RNA and DNA. That such a transfer was enzymic and not purely due to exchange reactions was shown in experiments in which boiled preparations were used.

In later experiments labelled nuclei were treated with D Nase and incubated with unlabelled cytoplasmic fraction. Under such conditions the cytoplasmic RNP incorporated much less P^{32} than the control, indicating a DNA control of RNA synthesis. If on the other hand the labelled cytoplasmic fraction is treated with R Nase (expected to affect both cytoplasmic and nuclear RNA) and incubated with unlabelled nuclei, P^{32} incorporation into nuclear DNA is increased as compared to that in the control. The increased incorporation is probably due to utilisation of the degradation products of RNA by the nuclei. DNA synthesis thus appears to be independent of both nuclear and cytoplasmic RNA.

129. Tracer studies in the post-harvest physiology and biochemistry of mango.

S. P. SAHA and S. P. SEN, Calcutta.

The biochemical changes occuring in detached mango fruit has been studied using $C^{14}O_2$ and Na acetate $-$ 1-C^{14}. Mango fruits in different stages of ripening were used intact or separated into peel and pulp. In the intact mature green (unripe) fruit, allowed to photosynthesise in $C^{14}O_2$, most of the C^{14} was located in the peel. The separated peel revealed the typical products of photosynthesis, in the peel of the intact fruit, however, very little C^{14} was located in sugars or amino acids. The pulp of the intact fruit incorporated relatively small amounts of C^{14} largely distributed in malic acid, sugar phosphates and a few amino acids but free sugars were practically free from radio-activity. As the period of storage was increased C^{14} activity in both the alcohol soluble and insoluble compounds of the peel gradually decreased accompanied with a corresponding increase in the radio-activity of the alcohol-insoluble fractions of the pulp. No marked change was observed in the activity of the alcoholsoluble fraction of the pulp. Phosphoglyceric and malic acids became increasingly radioactive while C^{14} activity in sugar phosphates gradually decreased. In the pulp $C^{14}O_2$ fixation pattern in light was identical with that observed in complete darkness. The pulp fixed more C^{14} in darkness than in light. In the peel C^{14} was fixed largely in sugar phosphates, phosphoglyceric acid and malic acid.

The ripe fruit with a green skin fixes more C^{14} into its peel and pulp than the fruit with a yellow skin. In the peel of the ripe fruit, very little C^{14} is found in sucrose even though the peel is green. A compound with low Rf values in phenol-water and Butanolacetic acid-water was detected only in the pulp of the ripe fruits. C^{14} activity in the peel, however, was always greater than that in the pulp no matter what the degree of ripeness was. Pulp of the yellow ripe fruit metabolised acetate $-$ 1-C^{14} only very weakly as compared to the green mature fruit.

130. Effect of Gibberellic acid on vegetative growth of *Spinacia oleracea* L.

B. SAMANTARAI and T. KABI, Cuttack.

The effect of gibberellic acid (GA) on the growth and development of *Spinacia oleracea* was studied. Soaking the seeds in aqueous solution of GA at different concentrations had little effect on the rate of germination, but the plants grown from the seeds soaked with 50 ppm. of GA showed more vegetative growth, than those treated with other concentrations and the controls. Periodical administration of GA showed promising results. There doses of GA at 10 ppm. induced best vegetative growth. The following criteria were considered to ascertain the vegetative growth : (1) Average number of leaves per plant, (2) Average number of branches per plant and (3) Fresh weight of the shoot.

131. Auxin control of secondary growth in the petioles of Herbaceous Dicot leaves. III—Enhancement of secondary growth by the application of synthetic hormones and inhibition of secondary growth by the application of auxin-antagonisers in the petioles of *Boerhaavia diffusa.*

B. SAMANTARAI and T. KABI, Cuttack. (Orissa)

Secondary growth does not take place in the petioles of *Boerhaavia diffusa*, when the leaves are attached to the stem. Profuse secondary growth in the petiole was observed when the leaves were isolated and treated with synthetic hormones.

So the leaves of *Boerhaavia* were selected to study the factors concerned in the secondary growth. Experiments were performed in three ways, viz., (1) with isolated leaves, (2) attached leaves with girdles above and below the nodes and (3) attached leaves without girdles. The hormones used in these experiments were β-indolyl butyric acid (IBA), β-indolyl acetic acid (IAA and α-Napthyl acetic acid (NAA). Auxin-antagonisers like Maleic hydrazide (MH), Phenyl mercuric nitrate (PMN), and 2,4-dichloranisole (DCA) were used in these experiments. To study the role of food factor, sucrose and asparagine and some 'B' vitamins were administered. Synthetic hormones, auxin-antagonisers and food substances were administered separately and in different combinations at different concentrations. It was revealed from these experiments that auxins whether native or applied enhanced secondary growth and auxin-antagonisers inhibit secondary growth either partially or completely. In the attached leaves, girdling the stem above and below the node produced secondary growth whereas ungirdled leaves had no secondary growth. Food substances like sucrose, and asparagine and 'B' vitamins did not produce any effect on secondary growth. Therefore it is suggested the secondary growth is chiefly brought about by the auxins which may be native or synthetic.

132. Factors concerned in secondary growth in the stem of *Solanum melongena* L.

B. SAMANTARAI and B. K. NANDA, Cuttack.

Investigations were carried out to determine the factors concerned in secondary growth in stems of *Solanum melongena* L. Plants were treated with β-Indolyl butyric acid (IBA) before any cambium was formed in them. Such plants produced copious secondary growth. The amount of secondary growth, when measured, was more than the untreated ones.

Administration of auxin-antagonisers like Maleic hydrazide (MH), Phenyl mercuric Nitrate (PMN) and 2, 4-Dichloroanisole (DCA) lowered down the magnitude of secondary growth. Repeated application of these substances completely inhibited secondary growth. These auxin-antagonisers, however, along with IBA, although reduced secondary growth could not inhibit it completely even under repeated administration.

Treatment with food substances like sucrose and Asparagine either singly or in combination with auxin-antagonisers did not brirng about any effective change. in fact, they had no significant role in controlling secondary growth.

The enhancement of secondary growth by the application of hormones and the inhibition of secondary growth by the application of auxin-antagonisers suggest that secondary growth in stems is primarily controlled by hormones.

133. A preliminary survey of auxin disappearance from the medium by slices of different plant material.

B. SAMANTARAI, S. K. SINHA and M. S. RAO, Cuttack.

One of the effects of auxins on plants is the induction of roots and secondary growth. But formation of roots and production of secondary growth by the application of synthetic hormones are not found in most of monocots and no rooting response in ferns. In order to investigate the fate of auxin that is externally supplied to different plant species slices of tissues were floated in solutions of IAA. The concentration of IAA at intervals of 20 minutes were determined by a method suggested by Tang and Bonner. The method consists of a ferric chloride-sulphuric acid reagent, when added to aqueous solution of IAA, a red colour is developed, which reaches its maximum intensity after 15 minutes. The red colour was then compared with Lovibond Tintometer. A standard curve was prepared with 50, 40, 30, 20, 10 and 5 ppm. (parts per million) of IAA against their respective readings expressed in Lovibond units. The plant parts investigated were cut in to uniform sized (1 mm.) discs and kept in 50 ppm. of IAA for 20 minutes. Then 1 c.c. of the aliquot was mixed with 4 c.c. of Tang and Bonner reagent and allowed to stand for 15 minutes when it developed its maximum intensity of colour. The colour was compared with Lovibond Tintometer. In the same way the readings were taken with all the aliquot at every 20 minutes interval. With the standard curve the Lovibond units were converted to ppm. The experiments were repeated with a number of plant species belonging to monocots and dicots and some ferns responsive and non-responsive as to rooting response or secondary growth as the case may be.

It was found that the disappearance of auxin from the incubation mixture was the most rapid in certain monocots especially in *Polyanthes* and in Ferns, where 50% of IAA disappeared in less than 20 minutes. No induction of roots or initiation of secondary growth is possible with IAA in Polyanthes and Fern. So the decrease of IAA from the solution supplied externally may be due to destruction by the tissues or inactivation by an unknown enzyme system present in the tissues. The destruction may be inside the tissues or in the medium since the cell sap which exude from the cut surfaces of the discs contain this enzyme system. This investigation has some important bearing in the problem of induction of roots and initiation of secondary growth by auxins. Further studies in this line are in progress.

134. On the effect of sound waves produced by Tuning Fork on the mitotic behaviour of *Urginea indica* Kunth (Indian Squill).

P. SANKARANARAYANA, Annamalainagar.

Since 1950, quite a lot of work has been done in the Botany Laboratory of Annamalai University on the effect of musical sound on growth and reproduction of plants. It has been seen that in plants like *Mimosa, Impatiens, Ipomaea* and others, vast perceptible histological changes take place as a result of excitation by sound. The size of the epidermal cells and palisade cells has been found to be larger in the experimental plants than controls.

Two sets of identical bulbs equal in size were grown in pots and in bottles maintaining other factors like soil and water also in an identical manner. One set served as the control and the other as experimental. The bulbs were excited by an electrically run tuning fork whose frequency was 96, for a period of 30 minutes. The root tips that emerged out from both the control and experimental were fixed in Acetic alcohol and acetocarmine squashes were made. It was noticed that the total number of cells that were undergoing division and the various stages of mitotic division in the experimental root tips was greater than those of the control. It was found that the coming out of root tips was earlier in the bottles containing water than in pots. The various stages of mitotic division were tabulated and statistically analysed.

It was evident that the sound waves of tuning fork have increased the rate of mitotic division. Interestingly enough, in the experimental root tips far more cells were in the meta-ana and telophose stages than in the controls. The inference is that the sound waves impinging on the protoplasm stimulates the otherwise quiescent nuclei to mitotic activity. The phenomenon of more vigorous growth is to be attributed to the stimulation of the cell protoplasm into greater activity which results in more rapid and more frequent nuclear division and the consequent increased growth rate and augmented size of plants concerned. Likewise here the mitotic division is speeded up by sound and this naturally results in the rapid elongation of the roots.

135. On the effect of sound waves on the growth and bio-chemical changes in the seedlings of *Sorghum vulgare* CO-19.

MISS P. P. SAROJINI, Annamalainagar.

In the present investigation, a study was made for the first time on *Sorghum vulgare* variety CO-19 under the excitation of sound waves produced by an electrically run buzzer.

Unlike other seeds where there is definite difference in germination under sound excitation, in this case there is however, ,no such difference in germination, under the influence of sound waves, except the difference in vigour between treated and non-treated seedlings. Experiments in petri-dishes were conducted by varying the period of excitation viz. 15 minutes, 30 minutes, 45 minutes and 60 minutes. Best results in the form of growth performance, have been obtained under 30 minutes excitation.

Respiration of the germinating seeds under different periods of sound excitation was also studied. It was observed that the optimum respiration values were obtained under 30 minutes and 45 minutes excitation.

Bio-Chemical analyses of experimental and control plants were done. Under pot-culture, 45 minutes excitation gives the best results with regard to shoot system, root system, C/N ratio, Cellulose content and total sugar. No difference has so far been found in respect of the nitrogen content. Further work is in progress.

136. Photoperiods in *Hyptis Suaveolens* Poit.

M. C. SAXENA, Raipur.

Hyptis suaveolens Poit. belonging to family Labiatae is an annual to perennial species widely distributed in Chhattisgarh Divison (M.P.). Being an annual it starts its growth in nature with the onset of monsoon. Flowering sets in by the end of October when the plants are nearly four months old and 1 to 2 m. high.

Plants of *Hyptis suaveolens* Poit. were grown in 3 replicates under 6 hour, 8 hour, 12 hour, 18 hour, 22 hour, 24 hour and normal photoperiods. Data has been obtained regarding the length of plant, vegetative and reproductive grgowth. The following facts are also noted concerning the response of this species to the length of the photoperiod :—

(i) The plant is a short-day one. Flowering takes place on the 44th day of transplanting the seedling with 8 hour photoperiod.

(ii) The plants with 6 hour photoperiod flower on the 49th day of transplantation.

(iii) There must be a critical length of photoperiods between 6 hour and 10 hour with respect to the age at which flower buds are initiated.

(iv) When the plants were exposed in lengthened photoperiods e.g. 16 hour, 22 hour and 24 hour the growth is more vegetative. These plants are fairly robust, with thicker stem, broader leaves and dense thick hairs.

137. Studies in Root Initiation in Isolated Cotyledons and in Different Portions of Hypocotyls of Mustard T. 102 Seedlings.

B. SEN and G. VERMA, Almora.

Similar cotyledons isolated from young seedlings of mustard T. 102 were cultured in (a) G.D.W., (b) nutrient solution ½ strength, (c) 20 ppm KNO_3 in normal day light and (d) in ½ nutrient kept in dark at room temperature. The number of cotyledons which developed roots and the time taken for root emergence were (a) 55% ; 9·7 days, (b) 90% ; 6·6 days, (c) 70% ; 8·2 days and (d) 52% ; 6·2 days. Cotyledons kept in dark had smaller blades and longer petioles.

From seedling hypocotyls of mustard T. 102 (length 20 ± 1 mm.) (A) 5 mm. apical fragments with cots, (B) 5 mm. apical fragments without cots, (C) top 5 mm. portion of hypocotyl without growing point, (D) middle 5 mm. portion and (E) bottom 5 mm. portions were isolated and grown for 2 weeks in ½ strength White's nutrient solution, alone and with IAA 0·5 ppm. Roots emerged earliest in (A) following by (E), (D), (C) and (B). With IAA the root emergence was 100% in (A), 76·7% in (E), 50% in (C), 48% in (D) and 40% in (B); without IAA it was 100% in (A), 50% in (B), 40% in (C) and 20% in (D).

Effects of removing one or both cotyledons from 2 to 5 mm. apical fragments of mustard T. 102 (i) in the beginning and after, (ii) 24, (iii) 48 and (iv) 72 hours on the sequence of root emergence in tissues grown in White's nutrient solution at room temperature were observed. In another set of apical fragments, the growing point was also removed with the cotyledons. It was found that cotyledons supplied all the necessary material for root and leaf emergence in the first 48 hours so that in (i) many of the tissues failed to develop roots and it took much longer time for the emergence of the first leaf and root, while the tissues of (iii) and (iv) were similar to the tissues with both cotyledons intact (controls). Where only one cotyledon was removed it was observed that even the one remaining cotyledon served to supply the necessary material for root and leaf initiation. The growth elongation of tissues was best in those with cotyledons intact and decreased in the expected order according to the number of cotyledons and period for which they remained attached.

This work was carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

138. Effect of Vitamins B_1, B_5, B_6, Glycine and of Gibberellic Acid and Potassium Nitrate on the Growth and Development of Apical Fragments of Mustard T. 102 Seedling Hypocotyls.

B. SEN and G. VERMA, Almora.

2 mm. apical fragments of mustard T. 102 seedling hypocotyls (length 12 ± 1 mm.) were grown for 2 weeks in (i) GDW, (ii) vitamin B_1 (Thiamine hydrochloride) 1 ppm., (iii) vitamin B_5 (Nicotinic acid) 5 ppm., (iv) vitamin B_6 (pyridoxine) 1 ppm., (v) glycine 30 ppm. and (vi) in a mixture of vitamins B_1, B_5, B_6 and glycine. It was found that the first leaf appeared first in treatments, (ii) and (vi); roots emerged significantly earlier in (vi) than in others; the growth elongation of tissues was maximum in treatment (vi) followed by (v) and similar in (ii), (iii) and (iv). Plants raised from tissues grown in (vi), (iii) and (ii) showed significant earliness in flowering, but the leaf stage at which the flowers appeared was lower only in treatment (vi).

2 mm. apical fragments of 15 ± 1 mm. hypocotyls of mustard T. 102 were grown for 2 weeks in (i) GDW, (ii) GA 50 ppm., (iii) GA + vit. B_1 1 ppm., (iv) GA + vin. 5, 5 ppm., (v) GA + vit. 6_6 1 ppm., (vi) GA + glycine 30 ppm., (vii) GA + vitamins B_1, B_5, B_6 and glycine and in (viii) GA + White's nutrient solution. Roots emergence was early oin in (viii). Compared to GDW all treatments induced significantly increased hypocotyl lengths but only treatments (vii) and (viii) induced better growth than GA. GA significantly suppressed root growth and the addition of vitamins B_1, B_5, B_6 and glycine only neutralised this effect to varying degrees. Only in treatment (vii) and (viii) significantly greater root growth was observed. Earliness in flowering was induced by treatments (iii), (vii) and (iv).

These studies were carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

139. Effect of Gibberellic Acid and Gibberellic Acid Like Subtances on the Growth Elongation of Pollen Tubes II.

B. SEN and G. VERMA, Almora.

The effects of incorporating in the germinating medium gibberellic acid (GA) with 5 amino-acids and 2 phenoxy compounds and GA like substances isolated from potato sprouts on the growth elongation of pollen tubes of Madonna lily (*Lilium condidum*) and of Sweet pea (*Lathyrus odoratus*) were observed.

GA + Amino Acids : Madonna lily pollen tubes were grown for 4 hours in (i) 12·5% sucrose solution containing, (ii) GA 0·1 ppm., (iii) Lysine 7·5 ppm., (iv) GA + Lysine, (v) Citrulline 10 ppm., (vi) GA + Citrulline, (vii) Cystine 50 ppm., (viii) GA + Cystine, (ix) Arginine 0·025 ppm., (x) GA + Arginine, (xi) Glutamic acid 0·025 ppm. and (xii) GA + Glutamic acid. Compared to the growth in (i) 720 microns, best growth elongation of pollen tubes was induced by (xii) 1890 microns, (iv) 1834 microns and (x) 1824 microns, followed by (xi) 1610 microns followed by (vi) 1414 microns, (ix) 1356 microns, (viii) 1314 microns, (iii) 1288 microns followed by (ii) 1024 microns, (v) 1064 microns and (vii) 908 microns.

GA + Phenoxy Compounds : Compared to the growth elongation of Madonna lily pollen tubes in (i) control medium, 998 microns, that induced in 5 hours by 12·5% sucrose solution containing, (ii) GA 0·1 ppm. was 1664 microns, (iii) 2, 4-D 1 ppm., 1398 microns, (iv) GA + 2, 4-D 2326 microns, (v) TIBA 0·5 ppm. 1196 microns and (vi) GA + TIBA 1864 microns.

Gibberellic acid like Substances : 1/50,000 water extracts of fresh sprouts of Potato tubers, containing gibberellic acid like substances induced significantly increased elongation of Sweet pea and Madoma lily pollen tubes. Compared to the length of Sweet pea and Madonna lily pollen tubes in control germinating medium, 604 and 1100 microns, the lengths of pollen tubes induced in 6 hours in 12·5% sucrose solution containing GA 0·1 ppm. were 738 and 1388 microns and in media containing 1/50,000 extract of potato tubers 884 and 1898 microns respectively.

These studies were carried out in connection with the Scheme of Plant Physiology and Cytology being financed by the Indian Council of Agricultural Research, New Delhi.

140. Germination and Growth of Madonna Lily Pollen Stored for One Year in Deepfreeze.

B. SEN and G. VERMA, Almora.

Madonna lily (*Lilium candidum*) pollen grains were stored in deepfreeze at −15 to −10°C. in glass and polythene vials and in butter paper packets sealed with scotch tape and kept in tightly stoppered conical flasks with or without $CaCl_2$. The pollen grains stored without $CaCl_2$ gave the best results, and some pollen grains germinated even after one year's storage in deepfreeze and showed satisfactory growth elongation.

One year old pollen grains were grown in sucrose-agar media (12·5% sucrose solution containing 1% agar) contaning (i) GA 0·1 ppm, (ii) citrulline 10 ppm., (iii) GA + citrulline, (iv) lysine 7·5 ppm., (v) GA + lysine, (vi) glutamic acid 0·025 ppm., (viii) GA+glutamic acid, (viii) cystine 50 ppm. and (ix) GA+cystine. Compared to germination of controlmedium , the germination induced by (ix) was 13·7%, (vii) 9·9%, (viii) 8·5%, (vi) 6·8%, (v) 6·0%, (iv) 4·3%, (iii) 3·8%, (ii) 3·7% and (i) 3·5%. Maximum growth elongation of pollen tubes was induced by (ix) followed by (v), (i), (iii), (viii) followed by (vii), (iv) followed by (ii), (vi) and by control.

One year old pollen grains were grown in 12·5% sucrose medium containing (a) GA, (b) GA + citrulline, (c) GA + cystine, (d) GA + 2, 4-D 1·0 ppm. and (e) GA + TIBA 0·5 ppm. Compared to 2·1% germination in control medium, that in cystine + GA was 8%, and in other treatments between 3 and 4%. Maximum growth elongation of pollen tubes was induced by GA + cystine and by (a), (b), (d) and (e) followed by control.

These results emphasize the role of cystine in the germination and growth of stored pollen of Madonna lily.

These studies were carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

141. Effects of Gibberellic Acid on Flowering of Mustard T. 102 Plants Grown in Autumn, Winter and Summer.

B. SEN and G. VERMA, Almora.

Plants of mustard T. 102 were sown in pots in autumn (October 11, 1960), winter (December 12, 1960) and spring (February 21, 1961). Effects of spraying the seedlings every week from the age of 2 weeks with 100 ppm. GA on the vegetative phase of plants were observed. In autumn sown plants, which grew and matured in falling temperatures, only the plants receiving the treatment from 2 weeks onwards (10 spraying in all) showed significant earliness in flowering by 5·2 days, while those receiving the treatment from the age of 4, 6 and 8 weeks flowered late.

In winter sown series, the effects of spraying plants from the age of 2, 3, 4, 5, 6, 7 and 8 weeks were compared with others receiving the treatment from 2 weeks onwards, where the spraying was stopped in different pots after the first, second, third, fourth, fifth and the sixth spraying. It was found that GA treatment is effective when given early to plants, so that the treatment which was given all the spraying and treatment which received only the first two sprayings induced similar earliness in flowering. Later sprayings only helped to maintain increased height.

In plants sown in March, which matured under conditions of high temperatures, none of the treatments induced any earliness in flowering. The treatment receiving all the spraying only showed increased height.

Vernalisation Experiments : Seeds of mustard T. 102 were vernalised for 3 weeks in October, 1960 in (i) GDW, (ii) 50 ppm. GA, (iii) GA + KNO_3, (iv) GA + B, (v) GA + IAA and (vi) GA + Nutrient solution and were sown in field plots. Compared to plants from seeds of treatments (i) those from (ii) to (vi) showed cignificant earliness (at 1% level) and flowered at a lower leaf stage.

The experiment was repeated in March, 1961, when fresh seeds were vernalised in same solutions and the seeds sown in fields, no earliness in flowering was obtained.

These results show that GA treatment is only effective when given during the winter months and not in summer.

These studies were carried out in connection with the Scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

142. Growth periodicity in Roots of *Tilia europaea* L. seedlings.

D. N. SEN, Prague.

There is no fixed seasonal periodicity for the formation of new roots in Lime, the growth depends prevailingly on external conditions. The growth in long and short root is not directly related to the shoot growth. The different soil conditions very much influence the formation and growth of long, short and mycorrhizal roots. Under moist and warmer climate the root growth is enhanced. Dry conditions very much inhibit the new root growth, so this periodicity appears to be mainly due to ecological factors. The new root growth in sandy oil starts in the last, whereas in humus and loamy soils it is earliest and continuous for a longer time. In the month of May and June the growth was observed to be at peak, which falls down in July.

Mycorrhizae are nothing but short fungal associated roots, without which the life span of them is much shortened. The infection of short roots take place in two stages. Primary infection is the external colonization of short roots forming an ectotrophic mantle, and the secondary infection is carried from older part of the mycorrhizae to the newly grown prolongation so that the hyphae project from inside towards outside in the form of setae around the whole newly grown portion, which is delimited by notch. If the infection for a new uninfected short root is of secondary nature then setae-like hyphae project all around the whole root and not at the apex alone. The misinterpretation of long and short roots have been the major cause of the confusion in younger stages of the roots. The infection in *Tilia europaea* has never been observed in thick long roots, and hence it is concluded that infection may be carried on from mycorrhizal roots to new short roots than from long roots to short roots, as a secondary infection. Primary infection of short roots is always from outside by colonization of fungi on the root surface.

143. Observations on the Root Ecology of *Tilia europaea* L. seedlings.

D. N. SEN, Prague.

Lime seeds are enclosed in a fruit having a hard pericarp which is impermeable in water and air, unless it breaks and rots, the germination is difficult. Normally the seeds have a dormancy of 2-4 years. It is also seen that seed setting in the fruits is also poor. Germination is of epigeal type and is quite slow. The embryonic leaves are entirely different from the next pair of leaves, which remain attached on the seedling for quite a long time. So in a dry and sandy locality the natural regeneration of lime is difficult.

The primary root has an apex from 0·5-0·8 cm in length and a root hair zone, next to which is the zone elongation having dying hairs. The hypocotyl turns red-brown and its elongation is distinct. There is a great tendency of the development of lateral roots if the primary tap root is destroyed, and so the establishment of young seedlings is only possible if the surface layers of soil have enough moisture. This may be considered an important factor in transplantation of seedlings together with shade.

The root apex has distinct histogens in the thick roots in comparison to thin roots or primary tap root. The plerome, periblem and peripheral part including columella are distinct. The origin of lateral roots is from pericycle which takes the similar pattern as the normal root apex.

144. Effect of Ionizing Radiation on the Germinability of Jute Seeds.

SUBIR SEN and K. T. JACOB, Barrackpore.

Two different types of radiation e.g. 50 Kv X-rays (dosages ranging from 20,000r to 100,000r) and gamma rays (from radio-cobalt source of World Agric. Fair, New Delhi, 1959—dosages ranging from 40.000r to 00,000r) were used to irradiate dry seeds of JRC 212 (*Corchorus capsularis*) and JRO 632 (*C. olitorius*).

Germination experiments with the seeds irradiated at different dosages reveal that :

(a) Only swelling of the seeds takes place without any sign of germination at dosages 140,000r to 200,000r of gamma rays.

(b) Small radicle only or radicle and plumule appear, followed by substantial necrotic killing of the seedling of JRC 212 and JRO 632 respectively at dosages 120,000r and 100,000r of gamma rays, and

(c) The cotyledons appear, but greatly reduced in size or curled. Seedlings at this phase may recover and give rise to plantules with the first vegetative leaf if the dose is sublethal e.g., 100,000r of X-rays for both the strains and 80,000r gamma rays for JRC 212.

LD^{100} for gamma rays appears to be located at 100,000r in case of JRC 212 and 80,000r in case of JRO 632, while LD^{50} is located near 60,000r in both the strains. For X-ray treatments the LD^{50} has been found to be located near 80,000r in JRC 212 and 60,000r in JRO 632, whereas LD^{100} appears to be beyond 100,000r in both the strains.

145. On the effect of sound-waves on the germination of seeds and the growth of seedlings in Certain Cotton varieties.

S. SHANMUGHASUNDARAM and K. S. THIRUMALAISWAMY,
Annamalainagar.

Even though much work has been done on cereals, pulses, oil-yielding and tuber-plants under sound excitation, no work so far has been done, on the effect of sound waves on the germination of seeds and growth of fibre-yielding-plants. In the present investigation a preliminary sttudy was therefore, undertaken to know the effect of sound-waves produced by an electrically-run tuning fork, on germination and growth of three varieties of cotton, namely, two varieties of American cotton *Cambodia* and one Asiatic cotton *Karunkanni*. All the three varieties showed earlier germination under sound excitation when compared with the non-excited seeds. On the other hand the excited seeds complete their germination earlier by at least four hours than the control.

Sound excited seedlings are able to grow better and their rate of growth is on an average 36% greater than the control.

Besides, the experimental seedlings had better developed and more profuse root-system than the control ones.

146. Effect of carbon and nitrogen sources on the production of a fungistatic substance produced by a species of *Fusarium* active against *Zygorrhyncbus*.

N. P. SINGH and K. C. BASU CHAUDHARY, Agra.

A *Fusarium* sp. has been reported by Singh and Sinha (1962) to have antagonistic affect on a species of *Zygorrhynchus*. This paper deals with the effect of carbon sources (xylose, arabinose, glucose, fructose and lactose) and nitrogen sources (ammonium nitrate, potassium nitrate, alanine, acetamide and urea) on the production of the active substance.

Results indicate that *Fusarium* sp. can utilize in varying degrees all the carbon sources employed in the experiment. Of all the carbon sources, lactose gives the greatest zone of inhibition (10·6 mm.). This sugar is followed by arabinose (10 mm.), zylose (10 mm.), fructose (9·3 mm.) and glucose (6·6 mm.). As lactose was found to be the best source of carbon, its effect in different concentrations (2%, 3%, 4%, 6%, 8%, and 10%) on the production was also studied and it was observed that with the rise in lactose concentration from 2% to 4%, there was also a rise in the production of the active substance. On further rise is lactose concentration, there was gradual decrease in the production.

Of all the nitrogen sources tested, potassium nitrate gave the maximum zone of inhibition (14·3 mm.). This is followed by urea (13·0 mm.), ammonium nitrate (10·6 mm.), acetamide (8·6 mm.) and alanine (7·5 mm.). When the effect of different concentrations (0·238%, 2%, 4%, 6%, 8% and 10%) of potassium nitrate on the production of the fungistatic substance was studied, it was observed that the optimum result was obtained at 2% concentration and there was decrease in the production on either side.

147. Localization of Acid Phosphatase in Ovules of *Tropaeolum magus* L.

S. P. SINGH, Agra.

Huge outgrowths from the suspensor of the embryo have been reported and are referred to as suspensor and placental haustoria. The localization of acid phosphatase in the fertilized ovules of *T. majus* has been undertaken to determine the role of these haustoria in the development of the embryo.

In the beginning, in all the cells of the proembryo the enzyme is mostly localized in their nuclei but after the differentiation of the suspensor, the enzyme is discernable in the nuclei of the embryonal cells only. At this stage, in the endosperm the test shows the richness of enzyme in both the cytoplasm as well as in the nuclei. The chalazal and the micropylar portions of the endosperm which are deeply lobed are comparatively more rich in phosphatase than other portions of the endosperm. It, therefore, appears that the micropylar and the chalazal regions of the endosperm actively absorb those substances which are associated with the activity of acid phosphatase.

At a slightly later stage of growth the suspensor produced haustoria from its micropylar end. The cells of these haustoria are elongated and twisted and are in contact with the vascular tissue of the placenta probably to absorb food material directly from the placenta for the growing embryo.

148. On the effect of sound waves on alcoholic fermentation.

T. C. N. SINGH, Annamalainagar.

Experiments were first conducted in the laboratory on the budding of yeast cells under excitation of the sound waves of an electrically operated buzzer. It was noticed that the activity of budding was very much more accelerated in cases wherever the sound excitation had been dosed.

Subsequently experiments were directed to examine alcoholic fermentation under the excitation of similar sound waves and it was curiously found that the alcohol yield had shot up to about 60% more over the control.

Thereafter, experiments were translated on commercial scale by exciting 2 hours daily a whole vat of fermenting molasses solution for a period of 3 days. The total hours of excitation during this period was therefore only 6 hours. After distillation it was found that the experimental vat had yielded alcohol to the extent of 84 velts whereas in the control it was only up to a maximum of 80 velts. This may be considered as a preliminary experiment under commercial scale. Even then the increased output of alcohol by 5% over the control has been found to be very significant. These experiments were further repeated with ample consistent confirmations. In term of money it may be disclosed that this increase of 5% would add about one lac of rupees annually to the income of a small distillery having fifteen fermenting vats.

Planning is still going on to secure these experiments on a much better and more efficient line of investigation by installation of electrically operated equipments for producing more harmonious sound throughout the fermenting liquor. My grateful thanks are due to Shri C. Saravanaperumal, Manager, Government Distillery (Pondicherry) for his very close co-operation in conducting these experiments.

149. Further studies on the effect of sound waves of *Nadeshwaram* on the growth and yield of paddy.

T. C. N. SINGH and A. GNANAM, Annamalainagar.

This paper embodies results of the past four crop years' experiment, beginning from 1956 on the effect of sound waves on the growth and yield of paddy at Sirkali. The first experiment however in this line was executed in early 1956, at Chidambaranathan pettai with the original musical sound of violin, but subsequently it was translated at Sirkali where a recorded music of *Charukesi raga* piped through *Nadeshwaram* was broadcasted to the field through loudspeaker. The variety used in successive years were CO-25, ADT-7, ADT-9 and CO-25 and the yields obtained in each year respectively were found to be 52%, 60%, 42%, and 36% more in the excited experimental plots as compared to their controls. Even when the yields of the experimental plots were compared with the maximum yielding capacity of plot during the preceeding 10 years, it was 60% higher on an average.

Periodical observations were taken on the height of the plants, number of tillers per clump, length of the spike, number of grains per spike and yield per cent and they have been statistically calculated and in each case it was found that the differences were highly significant in favour of the experimental.

In all such cases where observations were taken from the beginning, it was found that the differences in height were not significant in the beginning, but after one week it became significant at only 5% level and not at 1% level. But as the excitation continued it became significant at both the levels viz. 5% and 1% after 2 weeks.

These experiments carried during these four years have definitely shown without any shadow of doubt that sound-waves do affect salubriously the growth and yield of paddy crops.

150. Observations on Bio-chemical analysis of sugarcane under the excitation of sound-waves.

THAKURJI SURAJNARAIN SINGH, Sewagram.

It is well established that sound excited plants exhibit better growth, flower earlier and yield more than non-excited plants. The present study was undertaken to know the effect of sound waves on bio-chemical changes in plants. In experiments done at Abishekapakkam (Pondicherry), the sugarcane variety CO. 527 showed better vegetative growth under the excitation of broadcasted music.

Biochemical analyses of mother canes of both the experimental and control (obtained from the Abishekapakkam) were done in two periods. First analysis was done when the canes were nine months old and the second analysis was done when they were twelve months old. There is not much difference in dry weight between control and experimental in both the analyses. There is, however, a definite increase in the total sugar in the experimental plants. Cellulose content is more in control than in the experimental.

When the canes were 9 months old, C/N ratio is greater in control than experimental. After a period of 3 months, C/N ratio rose to 29% more than the control in the experimental plants. Therefore, it is clearly proven that bio-chemical changes do take place under the excitation of sound waves.

ECOLOGY AND FLORISTICS

151. An imperfectly known endemic Taxon of Kumaon Himalayas— *Falconeria himalaica* Hook f. *(Wulfenia himalaica)* (Hook. f) Pennell.

T. ANANDA RAO, Calcutta.

During a botanical exploration in the Kumaon Himalayas complete specimens of *Falconeria himalaica* Hook. f. were collected at Kalamuni pass at an altitude of 3000 meters. The rediscovery of this taxon is of interest because of its incomplete description and dubious systematic position. The present paper gives a detailed taxonomic description of this taxon.

152. Preliminary report of the Vegetation of Rameshwaram island with special reference to Sand dunes flora and habitat.

T. ANANDA RAO, Calcutta.

The paucity of information on coastal sand dunes and plant communities, especially in India, emphasises the importance of ecological studies in solving sand drift problem. Intense ecological relations of plant communities of Sand dunes are of special interest in view of their role and Sand binders and stabilisers of the mobile dunes.

The vegetation of Rameshwaram island is typically that of dry tropical umbrella type of scrub forest as it is seen in the nearest mainland of Ramnad district. The island vegetation distinctly falls into two regions. The Northern hump and the Southern sandy bleak area are very much different from one another in aspect and configuration of the vegetation. Their features are distinguished sharply with edaphic features and dominant plant communities in this preliminary report.

The vegetation of the Northern hump can be distinguished into strand and inland vegetation whereas the Southern area into Mangrove, strand and sand dune vegetation. The characteristic scrub type of vegetation of Northern zone is no longer present in the Southern zone, especially towards deep south the vegetation is completely absent. The chief factor for the destruction of the pre-existing flora is the prevailing strong desiccating wind that blows from April to November causing sand drift.

A close observation of the island flora revealed that in the recent past the Northern hump must have thick open scrubby formations with the principal constituent of *Acacia planifrons* and the Southern part of the island, which is now nothing but a sandy waste must have once borne a good cover of sedges.

The soil is mainly sandy varying in texture from very fine to fine and coarse mixed. Either they do not contain any organic matter or very little in the form of undecomposed small roots and leaves. Only soils from the slack moist belt and ant-hill zone in the Northern hump of the island are clayey sands with good water holding capacity. The slack soil contains a little undecomposed organic matter and ant-hill soil contains sufficient decomposed organic matter. The pH variation of Southern zone soils is narrow comparatively and it is wider in the soils of Northern zone and the lower limit of 7·2 pH here approaches the neutral. Calcium content of the soils of Northern zone is generally lower than in the soils of Southern zone. Chlorides in all the soils are high. Nitrate nitrogen contents of any significant value are either in the soils of slack belt in both the portions of the island or in the mangrove belt. It is highest in the ant-hill soil where there is a thick scrubby vegetation. Potash and phosphorus contents of all the soils are more or less the same.

153. Plant abnormalities from the Indian Desert.

M. M. BHANDARI, Jodhpur.

During studies on the flora of the Indian Desert, the following abnormalities have been observed in the local plants :

Proliferation of the flower :

Tephrosia purpurea Pers., *Tephrosia strigosa* (Dalz.) Santapau and Maheshwari, *Pedalium murex* Linn. and *Argemone maxicana* Linn. In both the species of *Tephrosia* instead of a normal carpel a pinnate compound leaf developed while in some other cases a leaf-like structure similar to the terminal leaflet of *Tephrosia purpurea* Pers. and the normal leaf of *T. strigosa* (Dalz.) Sant. & Mahes. arise. Proliferation of the flower and malformation of the floral parts also occur in *Helianthus annus* Linn. and *Oscimum basilicum* Linn. both being garden plants.

Fasciation of the stem :

Euphorbia caducifolia Haines, *Leptadenia pyrotechnica* (Forsk.) Dine. and *Cocculus villosus* DC.

Fasciation of roots :

In the young plants of *Crotalaria burhia* Ham. growing on sand dunes.

Fasciation of inflorescence axis :

In cultivated *Cassia fistula* Linn. fasciation of peduncles and pedicels of the flowers has been observed.

Double carpels :

In *Cassia auriculata* Linn. the occurrence of bicarpellary apocarpus condition has been found more than once.

154. New Plant records for N. W. Indian Desert.

M. M. BHANDARI, Jodhpur.

During the course of study of Indian Desert plant for some years past, about 100 species of the plants have been collected from N.W. Rajasthan Desert which have not hitherto been reported from this area. Of these about 50 plants which have been finally determined, are listed below. Many of these plants are common in the adjacent areas. Some of these new records are of the plants which have been wrongly identified in the past like *Euphorbia caducifolia* Haines, *Indigofera astragalina* DC., *Flaveria australasica* Hook., *Tribulus cistoides* Linn., *Tephrosia fulciformis* Ramaswami and *Withania coagulens* Dunal. Some plants like *Acanthospermum Hispidum* DC., *Martinia annua* Linn., *Dentella repens* Frost., *Justicia heterocarpa* T. Anders. and *Iponica muricata* (L.), Roth. appear to be new in the area. Following is the list of new records family wise :

ACANTHACEAE : *Barleria cristata* var. *dichotoma* Prain, *Hygrophylla polysperma* T. Anders., *Justicia heterocarpa* T. Anders.; ASCLEPIADACEAE : *Ceropegia bulbosa* Roxb., *C. bulbosa* var. *lushii* Hook., *Dregea volubilis* Benth. ex. Hk. F.; CAESALPINEAE : *Cassia obtusifolia* Linn. & *C. occidentalis* Linn.; CAPPARIDACEAE : *Maerua arenaria* (DC.) Hook. F. & Thoms.; COMBRETACEAE :

Anogeissus coronata Starf.; COMPOSITAE : *Acanthospermum hispidum* DC., *Flavoria australasica* Hook., *Gnaphalium indicum* Linn., *G. purpureum* Linn. and *Pluchea wallichiana* DC.; CONVOLVULACEAE : *Cuscuta chinensis* var. *ciliaris* Engelm., *Ipomea coptica* (Linn.) Jacq., *I. muricata* (Linn.) Roth. R. & Set., *I. nil* (Linn.) Roth., *I. pilosa* Sweet., *Merremia dissecta* (Jacq.) Hallier, *M. quinquefolia* (Linn.) Hallier; EUPHORBIACEAE : *Euphorbia caducifolia* Haines, *E. heterophylla* Linn. and *Securinegea virosa* (Roxb.) Pax. et Hoffm.; LILLIACEAE : *Urginea indica* (Roxb.) Kunth.; MALVACEAE : *Althea ludwigii* Linn., *Hibiscus lobatus* (Murr.) O. Ktze., *H. punctatus* Dalz. and *Malvastrum coromandelianum* (Linn.) Garcke.; MARTINIACEAE : *Martinia annua* Linn.; ONAGRACEAE : *Jussia perenis* (Linn.) Brenan; PAPILIONACEAE : *Indigofera astragalina* DC., *Rhynchosia aurea* DC., *Tephrosia fulciformis* Ramaswami, *Trigonella occulta* Del. ex DC. and *Zornia diphylla* (Linn.) Parsoon; PORTULACACEAE : *Talinum paniculatum* (Jacq.) Gaertn.; RUBIACEAE : *Dentella repens* Forst.; SCROPHULARIACEAE : *Bacopa monnieri* (Linn.) Pennell, *Kickxia ramosissima* (Wall.) Janchen., *Veronica agrostis* Linn. and *V. anagalis* Linn.; SOLANACEAE : *Withania coagulens* Dunal.; TILIACEAE : *Triumfetta brartramia* Linn.; ZYGOPHYLLACEAE : *Tribulus cistoides* Linn.

155. Floristic composition of some chir (Pinus roxburghii) forests of India.

H. P. BHATNAGAR, Dehra Dun.

Chir (*Pinus roxburghii*) forests are found to occur in the outer ranges and principal valleys of the Himalaya and on the ridges of the Siwalik hills. Chir forests are flanking the Himalayas from 1,5005 to about 7,500', and occasionally higher. An attempt has been made in this paper to give some account of the important flora of some chir forests of India, as also their spatial distribution. For this purpose the collection of species were made during the phytosociological studies of some chir forests of India. These studies were conducted in Jammu & Kashmir, Punjab, Himachal and Uttar Pradesh in various forest divisions. Floristic and structural studies of these forests revaled an assemblage of about 180 species belonging to 57 families. Their spatial distribution was carefully recorded in terms of phytosociological attributes (rare, occasional, common and abundant) to work out their dynamic tendencies in due course.

These studies have revealed that though chir is typically a gregarious tree, forming pure forests of considerable extent, it is often mixed with other species. In its natural zone it is associated with the following tree species, *Pyrus pashia, Sapium sebiferum Mallotus phillipensis, Litsaea umbrosa. Olea cuspidata, Ficus roxburghii, Celtis australis, Xylosoma longifolia.* The common shrub species are, *Carissa opaca, Inula cappa, Indigoferra pulchella, Mimosa rubicaulis, Randia tetrasperma, Flemingia fruticulosa, Jasminum arborescens, J. humile, Dodoanea viscosa, Myrsine africana, Rosa muschata, Leea romusta, Murraya koenigii, Hypericum cernum, Thamnocalcamus aristatus, Berberis lycium, Lespedeza sericea Lonicera quinquelocularis, Prinsepia utilis.* The common species of herbs are *Dicliptera bupleuroides, Justicia simplex, Oxalis corniculata, Oplismenus compossitus, Cassia tora, Alium sp, Urena lobata, Sida veronicaefolia, Fragaria indica, Adiantum sp., Asplenium sp., Micromeria biflora, Hemegraphic latebrosa Blumea oxyodonta, Souchus aryensis,* and *Vernonia roxburghii.* Common climbers are *Rubus Saniculaus, Smilax aspra, Cayratia carnosa, Ichnocarpus frutescens.* Towards its upper limit its common companions are *Cedrus deodara, Pinus wallichiana, Quercus incana, Rhododendron arboreum, Pieris ovalifolia, Myrica nagi.* Towards the lower limits chir is associated with, *Shorea robusta, Anogeissus latifolia, Ougeinia dalbergioides, Buchanania lanzan, Bauhinia retusa, B. variegata.* In dry and open places at lower elevations *Euphorbia royleana* is the common shrub. In many chir forests at elevation higher than 4,000 ft. and over the undergrowth consists of a shrubby growth of *Rhododendron arboreum* and *Pieris ovalifolia.*

156. Vegetation cartography of south and north districts according to the method of gaussen.

M. V. DABHELKAR, Bombay.

In the present work, an attempt has been made to map out the vegetation of South and North Arcot districts using Gaussen's method.

This method has been applied for the first time in India at the scale of 1 : 253,440. The first map at the scale of 1 : 1000,000 of South India up to 12° latitude had already been prepared by Gaussen and his co-workers (1961).

The following features have been shown on the map :

1. Natural vegetation or the forest types.
2. Introduced vegetation.
3. Irrigation.

1. Natural vegetation is divided into four types of which two are climatic and two are edaphic. The edaphic types are the strand and Mangrove vegetation and are represented by red dets and violet lines respectively. Both the edaphic types are located in coastal zone. The climatic types viz. the series of *Albizzia amara* and *Acacia leucophloea* and the series of *Tectona grandis* and *Terminalis* sp. are shown by orange and yellow colours respectively. The physiognomy and the existing conditions of the forests are depicted with different symbols.

2. Introduced vegetation is divided into two parts viz. cultivations of cereal crops and the plantations of the trees. The main crops in the districts are paddy, millets, groundnut, pulses and sugarcane. The plantations are of *Casuarina equisetifolia, Anacardium occidentale, Mangifora indica, Coces munifora* and Betel vine.

3. Irrigation is by dams, channels, tanks and reservoirs.

Apart from the main map of vegetation, Inset maps at scale at the scale of 1 : 1000,000 are also shown and these are as follows :

A. Map of survey sheets at 1 : 1 mile.
B. Plesioclimax map.
C. Soil map.
D. Geological map.
E. Map of administrative divisions.
F. Bioclimatic sap.
G. Map of Agriculture.
H. Map of Xerothermic indices and Hypsometry.

Therefore, the above studies show that the tropical vegetation can be mapped out successfully at the scale of 1 : 253,440 according to the method of Gaussen.

The International map at 1 : 1000,000 which is prepared by Gaussen and his co-workers gives only a general idea about the vegetation types while the present districts maps being at larger scale i.e. at 1 : 253,440 (or 1 : 4 miles) show detailed information on the vegetation types.

In India, therefore, the mapping of the vegetation should be carried out district-wise at the scale of 1 : 253,440 or even taluk-wise at the scale of 1 : 63,360. The scale such as 1 : 1000,000 is of little use to our country as it gives only the general outline of the vegetation of the region.

157. Succession of vegetation in south and north Arcot districts.

M. V. DABHELKAR, Bombay.

The succession of vegetation in South and North Arcot districts has been traced and is presented in this paper.

It was shown that—

In the plains, cutting and grazing are very active and therefore most of the forests are in a very degraded condition. The Plesioclimax in these areas is formed by *Albizzia amara* and *Acacia leucophloea.*

The edaphic facies are *Memecylon edule* and *Manilkara hexandra* and they are conspicuous on soils which are derived from Cuddlore and sand-stone. The other facies viz *Euphorbia antiquorum* and *Pterolobium indicum* grew on soils which are highly leached, low in Exchangeable ions, and with gravels.

On the hills, the active biotic factors of burning cutting and grazing have also reduced the status of the original vegetation. The dry deciduous forests up to 1500 ft. which are dominated by *Anogoissus latifolia* is regarded as "Sub-climax" while the "Plesioclimax" consists of *Tectona grandis* and *Terminalia* sp. which are characteristic representatives of the Southern moist deciduous forests.

158. Climatic zones in relation to the forest types in south and north Arcot districts.

M. V. DABHELKAR, Bombay.

Champion (1936) has sought to explain the distribution of forest types of India in relation to climatic factors such as rainfall and temperature.

In the present work, the distribution of the forest types of South and North Arcot districts was studied in relation to rainfall, temperature, xerothermic indices, and dry period.

It was shown that—

The dry evergreen forests are restricted to t^5 r^2 x^3 d^3 climatic zone while the pure thorn scrub forests are distributed in the remaining climatic zones formed by the combination of t^5 r^3 r^4 x^3-$x^{3\text{-}4}$ and d^2-d^3. This shows also that the thorn scrub forests have wide ecological amplitude and thus those forests are distributed all over the plain in the districts.

The distribution of the dry deciduous and moist deciduous forests is dependent on the elevation and consequently on climate. The best developed forests are situated in the climatic zones viz. t^5 r^1 x^3 d^2 and t^4 r^2 x^4 d^1.

159. Edaphic factors in relation to the forest types in south and north Arcot districts.

M. V. DABHELKAR, Bombay.

In this paper, the influence of edaphic factors such as Geology and soils on the distribution of the forests has been discussed.

It was found that—

The dry evergreen forests are characteristics of Cuddlere sandstones and are conspicuously absent from the ether geological formations. The other forest types viz. Southern thern scrub forests, Southern dry deciduous forests and Southern Moist deciduous forests are distributed irrespective of the geological formations.

On the red earths, the predominant forest type is the thern scrub forest in the plains and the Sevennah type of dry deciduous forest on the hills.

Most of the thern scrub forest species grow well on acidic as well as on algaline soils. While the deciduous forest species prefer slightly alkaline soils.

Anegeissus latifolis, exhibits good growth on soils rich in exchangeable ions.

The results on the Organic matter show that the constituents of the forests soils depend upon the forest cover.

160. Plant records—I.

K. M. M. DAKSHINI, Derhadun.

During the extensive vegetational studies of Mothronwala Swamp, Forest many new plant species, new to the area have been collected. The present paper reports the occurrence of the following ten species not reported from Dehradun and its neighbourhood; *Viola canescens* Wall. (Violaceae); *Borreria ocymoides* DC. (Rubiaceae); *Adenostemma viscosum* var. *elata* Hook. f.; *Blumia lancelara* Druce; *Blainvillea acmella* (Linn. f.) philipson; *Echinops cornigerus* DC. (Compositae); *Lindernia hookeri* sub. sp. *kumaunensis* Pennell. (Scrophulariaceae); *Machilus oboratissima* (Wall.) Nees. (Lauraceae); *Curculigo orchioides* Gaertn. (Hypoxidaceae); *Gagea reticulata* Schultes. f. Brief notes, valid name etc. are given in the text.

161. An ecological study of the lac bearing trees (Butea monosperma) of 'Damda' Purulia P.S.

B. B. DAS, Purulia.

The area under review is 'Damda', a protected area under the supervision of the Directorate of Industries of the Government of West Bengal. It is the seed-lac producing centre of the State Government.

It is situated at approximately 23° 20' N latitude and 86° 23' E longitude. It occupies an area of 45 acres. The average altitude of the area is above 700 ft. above the sea level. The climate is of monsoon type with maximum summer temperature of 42°C in May-June and minimum winter temperature of 13°C in December-January. The annual rainfall is just over 50 inches mainly precipitated by the N-E monsoon.

The soil is poor and the soil texture varies from clay to sand. This is acidic to neutral and the soil pH from 5·9 to 6·8. The quantity of soluble salts present in the soil is normal (0·03% to 0·5%). The quantity of available nitrogen, phosphorus and potassium is found to vary from place to place. The nitrogen content of the soil is very low (90 to 210 lbs/acre). The phosphorus content of the soil is also very low (10 to 26 lbs/acre). But the potassium content is medium (160 to 300 lbs/acre).

The number of Palas (*Butea monosperma*) counted in the area is 4080 of which 2080 are full-grown trees having attained a considerable height of 15 ft. or more. The rest (2000) are all small plants and all of them are below 5 ft. in height.

The area covered by Palas (*Butea monosperma*) is about 25 to 30% of the total area of 45 acres. But the quadrat study gives a quite different picture. From the above study it has been found that Palas (*Butea monosperma*) occupies about 87% of the total area of 1000 sq. ft. of the 10 quadrats with minimum of 50% in quadrat No 1 and the maximum of 100% in quadrat Nos. 4,6.7. & 9.

The production of seed-lac is 4 to 5 seers per adult tree,

162. "Some observations on the spore-forming bacteria associated with the silkworm larva, Bombyx mori Linn."

R. K. GHOSH, Berhampore.

While studying on the normal alimentary flora of the silkworm larva, two spore-forming bacteria, viz. *Bacillus subtilis* and *Bacillus megaterium* were isolated. Sawamura (1906) described *Bacillus megaterium* as pathogenis to silkworm, while Jameson (1922) isolated the same from the normal and diseased silkworm larvae.

Bacillus subtilis, though a common spore-forming species widely distributed in nature, is reported for the first time in association with the silkworm larvae.

163. Studies on the vegetation of Bhimashankar ranges and its surrounding areas of Khed Taluka.

K. P. JANARDHANAN, Poona.

Preliminary observations made on the vegetation of the Bhimashankar ranges and its surrounding areas of Khed taluka are presented in the paper.

The area studied lies within the longitude 73° 30′ 5″-74° 3′ 5″E and latitude 18° 37′ 1″-19° 17′ 4″ N on the north western part of the Deccan plateau and is comprised of undulating hilly country. A survey of the vegetation of the area indicates that it has five main types of vegetation—(1) Evergreen shola type, (2) Semi-evergreen type, (3) Dry deciduous type, (4) Scrub jungles and (5) Grasslands. The successional status of the different types of the vegetation and the factors affecting them have been discussed. 415 species of vascular plants belonging to 77 families have so far been studied with a view to prepare ultimately a Flora of Khed taluka. Out of these, the largest families with the number of species in each are Leguminosae (66 Sp.), Gramineae (31 Sp.), Compositae (26 Sp.), Euphorbiaceae (18 Sp.), Acanthaceae (16 Sp.), Labiatae (14 Sp.), Rubiaceae (10 Sp.), and Commelinaceae (10 Sp.). These 8 families represent nearly 50 per cent of the total flora of the area under study.

Dendrophthoe falcata (Linn. fil.) Etting., *Dendrophthoe trigona* (Wt. & Arn.) Danser ex Santapau, *Taxillus cuneatus* (Roth) Danser, *Macrosolen capitellatus* (Wt. & Arn.) Danser, *Scurrula philippensis* (Cham. & Schlecht.) G. Don., *Viscum articulatum* Burm. f. etc. are some of the tree parasites frequently found in the area. A root parasite commonly found is *Striga gesneroides* Vatke es Engler. Among the plants of medicinal importance generally found here, mention may be made of the following—*Argemone mexicana* Linn., *Azadirachta indica* Juss., *Boerhavia diffusa* Linn., *Cardiospermum halicacabum* Linn., *Cassia fistula* Linn., *Cynodon dactylon* Pers., *Hemidesmus indicus* R. Br., *Emblica officinalis* Gaertn., *Gymnema sylvestre* R. Br., *Pongamia pinnata* (Linn.) Pierre, *Terminalia chebula* Retz. etc.

Viscum articulatum Burm.f.var. *thelocarpum* (Danser) Seshagiri Rao, *Commelina subulata* Roth, *Cyanotis cucullata* Kunth, are some of the interesting new records from the area.

164. Additions to the flora of Mt. Abu, Rajasthan.

K. C. KANODIA and MISS U. R. DESHPANDE, Poona.

While preparing a comprehensive list of plants, collected during several explorations from Mt. Abu area in Rajasthan State more than seventy species of Angiosperms and Cryptogams have been found new to the area. Out of these the following is the list of the interesting species :

Commelina kurzii, Erythrina stricta, Ficus lacor var. *wightiana, Galinsoga parviflora, Grewia glabra, Hemigraphis hirta, Indigofera subulata* and *Leucas biflora* var. *procumbens* have not been recorded also from Punjab, Rajasthan and Gujarat States.

Alternanthera repens, Clitoria biflora, Ficus lacor var. *wightiana, Indigofera subulata, Hemigraphis elengans* var. *crenata Vandellia nummularifolia, Silene concidea* and *Telanthera ficoidea* have not been recorded from Behar, Orissa, Bengal and Assam States also.

Alternanthera repens, Erythrina stricta, Hemigraphis elegans var. *ocrenata, Murdannia nudiflora, Sida glutinosa* and *Triumfetta annua* are not reported even from Uttar Pradesh.

Clitoria biflora, Hemigraphis hirta, Medicago dentiulata Silene conoidea, Stellaria media, Triumfetta annua and *Vandellia nummularifolia* have not been recorded from Kerala State.

Hemigraphis hirta, Indigofera subulata, Leucas biflora var. *procumbens, Silene conoidea* and *Stellaria media* have not yet been recorded from Maharashtra State.

Out of the Hepatio flora of Mt. Abu, *Anthoceros longii, Fimbriaria angustata, Plagiochasma intermedium* have not been reported previously.

Among the rich fern flora *Asplenium lunulatum, Athyrium hohenckerianum, Cheilanthes varians, Diplazium sylvaticum* and *Lastrea crenata* are the new records for the area.

Various details on the distribution, habitat of the new records for the area together with a comparative systematic list of the species are given in the paper.

165. Ranunculaceae in Assam and North East Frontier Agency (N.E.F.A.).

S. K. KATAKI and G. PANIGRAHI, Shillong.

After the publication of the "Flora of Assam" by Kanjilal, Das, *et al* (1934), the sporadic collection tours undertaken in the Abor hills (Burkill 1924), in the Aka hills (Bor 1938) and between the Foot hills and Bomdila (Srinivason 1960) have added valuable, though meagre data, to the Botany of Eastern India.

The exploration tours by the Eastern Circle of the Botanical Survey of India between 1955-1960 have yielded significant new data both on the vegetation and flora of the vast untrodden tracts of Assam snd N.E.F.A. (Rao and Panigrahi, 1961).

This paper presents an enumeration of 11 genera with 36 species of the family Ranunculaceae, collected during these tours, furnishes important notes on the habit and habitat of each species together with exact localities of occurrence and abundance in the areas and classifies in a tabular form, the altitudinal range of distribution of each species.

It appears that *Anemone rupestris* Wall (Sela—3000 m. Rolla 9663), *Caltha palustris* L. (Senzedzong 4600 m. Rolla 7794), *C. scaposa Hk.* f. & T. (Senzedzong 4600 m. Rolla 7741) and *Isopyrum adiantifolium* Hf & T (Chakoo 2900 m. Panigrahi 16084), are new records of species for Assam and NEFA and *Clematis acutangula* Hk. f. & T. and *Coptis tecta* Wall. turn up as endemic species to Eastern India. Whereas *Caltha* spp. and *Ranunculus hirtellus* Royle are restricted to temperate and subalpine altitudes, a few genera viz. *Anemone, Clematis* and *Ranunculus* are distributed over tropical, subtropical and temperate forests in the area. *Anemone rivularis* Ham., *Clematis gouriana* Roxb. are a few of the 10 species with widest distribution in the area and extend their range of distribution to the neighbouring countries e.g. Ceylon, Java, Philippines, America etc.

166. The intruding weeds of the Nilgiris.

N. K. LAKSHMANAN, Annamalainagar.

The Nilgiris District is situated in a converging angle, where Mysore, Madras and Kerala States meet each other and where eastern & western Ghats merge with each other. It falls between the latitudes 10°1′N and 110°45′N and the longitudes 76°0′E and 77°15′E. Being a hilly district it has got a variety of species representing temperate, tropical and sub-tropical species.

An attempt has been made to focus the attention of Botanists towards the problems of the weeds of the Nilgiris. Reading the medicinal and economical values of the weeds, the author disagrees with the earlier definitions of weeds as "useless and waste plants"; and defints a weed as 'a plant, mainly herb or shrub, which grows by its own accord, in a place where it is not desired or where the hindrance by it is felt." For exuberance, dominance, endurance and migration, weeds have got at least some of the following characters. (1) Enormous out-put of seeds, (2) Greater viability of seeds, (3) Durability of seeds, (4) Special means in the dispersal of seeds, (5) Special means in the propagation of species, (6) any means to escape from Biotic factor and (7) suitable edaphic or climatic conditions. The weeds of the Nilgiris could be broadly classified into (a) weeds of the plantations, (b) weeds of the cultivated fields, (c) weeds of the road-sides and (d) weeds of the denuded forest areas, grasslands and other waste lands.

The commonest weeds, according to dominence, are (1) *Lantana camera,* (2) *Eupatorium glandulosum,* (3) *Oxalis spp,* (4) *Tridax spp.* (5) *Biden spp,* (6) *Helichrisum brachitiatum,* (7) *Cytisus scoparius,* (8) *Ulex europeaus,* (9) *Solanum gigantium,* (10) *Dodonea viscosa,* and (11) *Acacia dealbata.* The very striking and salient feature is that all the weeds are exotic species which were introduced to the gardens. Their escape from the gardens and becoming wild and predominating all over the Nilgiris is something notable. Upto recently *Eupatorium glandulosum* was the most dominating weed. Now the place has been taken up by *Lantana camera,* which is a latest addition. It is pitiable to note that *Helichrisum brachtiatum,* which is one among the beautiful and lovable garden plants, is becoming a dominating weeds. Hence, it is felt that it is worthwhile if a thorough Ecological study on the weeds of the Nilgiris is taken up.

167. Studies on the Angiospermic Hydrophytes of Patna.

MAHENDRA THAKUR, Patna.

As far as the author is aware no systematic account of the hydrophytes of Patna has appeared so far. Indeed some brief references to the hydrophytes of this place have been made by Haines (1926) and Srivastava (1956) but these descriptions are very meagre. Hence an attempt has been made to give a somewhat detailed account of the hydrophytes of this place.

Patna is situated at 25°-37′ north latitude and 85°-10′ east longitude. It is about 180 ft. above the sea level and the soil is chiefly sandy loam. It possesses a monsoon type of climate. The hot wet season is from the 15th June to 30th of September. The rain fall is about 48″ per annum, the heaviest portion in July and August. An interesting point noticed is that the rain fall has been gradually decreasing and has been very irregular, and most of the time it rains in torrents rather than in steady showers. The maximum temperature is 115°F in June and the minimum winter temperature is 36°F in January. The relative humidity is 51 in May and 86-87 in July-August. The summer temperatures have gradually been rising and the relative humidity falling so that there are signs of slow desiccation in the area.

From the present studies of the hydrophytes of this locality following conclusions are made :—

(1) The dominant family, according to mere number of species, is Hydrocharitaceae.

(2) *Eichornia crassipes, Solms.* belonging to the family Pontederiaceae is the most dominating single species.

(3) In general aquatic monocots are more common than aquatic dicots.

(4) *Trapa bispinosa Roxb.* is the only species cultivated for its edible fruits and *Nymphoea* species are cultivated in the gardens for ornamental purposes.

(5) Forty seven hydrophytes belonging to 25 families are found in this locality.

(6) As there has been no previous account of the hydrophytes of this area, it is difficult to ascertain the number of newly introduced species, but it cannot be ruled out that some of them have been recently introduced due to changes in the climatic and biotic factors.

168. The weed flora of Darbhanga District (Bihar)—I. Paddy Field Angiospermic Weeds.

MAHENDRA THAKUR, Patna.

Darbhanga district is almost in the centre of North-Bihar and lies between 25°-28′ and 26°-46′ North latitude and between 85°-31′ and 86°-44′ East longitude. The entire district is wholly flat, devoid of hills unlike South-Bihar, and the soil is of alluvial type. The climate is of monsoon type with maximum summer temperature of 110°F to minimum winter temperature of 50°F and the average annual rain fall is approximately 45″. It is very much affected by the floods of rivers like Kosi, Kamala, Burhi Gandak and the Ganges. Paddy is the chief cultivated crop of this district.

A systematic account of the large number of paddy field weeds of this district has been put on the record for the first time. These weeds on systematic classification show that the dicotyledonous families are more in number than the families belonging to the monocotyledonous group, and the mnnocotyledonous families—Cyperaceae and Gramineae predominate over all other families in having large number of plant-species. The monocotyledonous families are more in number on medium and low lands than they are found on high lands. The dicotyledonous and monocotyledonous genera are almost equal in number, but the monocotyledonous species are more in number than dicotyledonous species. The preponderance of the monocotyledonous species may be assigned to the production of large number of seeds which are light in weight and easily dispersed both by air and water. As there has been no previously account of the Rice-field weeds of this district it is difficult to ascertain either the number of recently introduced species or the species which have been eliminated in course of time. Further studies on the weeds of this district are in progress.

169. Phytogeography of the genus *Stipa* L.

K. C. MISRA, Banaras.

Stipa is a sub-cosmopolitan genus including more than 350 species. The distribution pattern of various members of this genus, and evidence provided by fossil plants of Stipoideae from North America, shows the antiquity of the taxan. The present investigator has made a phytogeographic study of the genus, and the lines of evidence, from the areal pattern of distribution, from the morphological, cytological and ecological studies, suggest that the genus evolved in a southern land mass, occupying the South Pacific Region. The study has indicated that from this geological land mass, *Stipa* migrated northward along two channels. On these routes, four secondary centres of development were established and the modern Stipas migrated from these centres.

This involved migration to North America from South America, which is contrary to the existing belief that *Stipa* is of northern origin and migrated into North America from Asia by way of Alaska (Clements 1920, Beetle 1957).

170. Edaphic Conditions and Pond Vegetation.

H. P. MEHTA, Varanasi.

The substratum of the temporary ponds of Varanasi remains covered with water for nearly four to eight or nine months according to depth, following July each year. These low-lying areas present a heterogenous environment due to differences in size and period for which they retain water.

It has now been well stablished that aquatic plants and more particularly rooted aquatics depend on the substratum for their nutrients. The relation between growth, distribution and behaviour of plants, in both dry as well as aqueous phases of ponds, and the physico-chemical properties of substratum are studied.

From March to June these ponds remain dried up and plants characteristic of this phase appear. Profile study of the substratum has been made. Samples from different depths are quantitatively analysed by volumetric, flame photometric and spectrophotometric methods.

The vegetation is interpreted in terms of topographic differences and variations of ionic concentration of exchangeable Na, Ca, K, Mg, CO_3, NO_3, Organic matter and pH. The correlation between zonation and behaviour of vegetation and spatial and temporal changes in physico-chemical characters of substratum have been established.

171. Some observations on the morphology and biology of *Cleome chelidonii* Linn.

M. V. MIRASHI, Nagpur.

The paper draws attention to the essentially hydrophytic nature of this species. It has been found that the species tolerates a wide range of habitats but retains its anatomical feature indicative of adaptation to water environment, viz., the lacunar pith.

Further, the species has been shown to be a *hemicryptophyte* and not merely an annual as described usually in our floras. Experiments have proved that the hemicryptophyte is capable of sprouting throughout the year in presence of adequate quantity of water. The species is sensitive to soil drought rather than atmospheric dryness.

The paper describes some other significant features in the life-history of this species.

Lastly, it reports the existence of an *ecotype* which differs from the usual rainy season population of this species. This ecotype is a dry season form which shows characteristic differences in the growth season, floral features and anatomical characters. There is nothing in the structure or biology of this form that is even remotely suggestive of a life adapted to watery environment. Experimental cultivation of these forms has shown that the two are not interconvertible and that the distinctive features of each are hereditary.

The dry season form has been found to grow only as an annual; the benefits of a hemicryptophytic habit being denied to it. This may explain the rare and sparse occurrence of this ecotype.

172. Genue *Hedychium* in Eastern India.

V. N. NAIK and G. PANIGRAHI, Shillong.

Genus *Hedychium* Koenig (1783) is represented in Eastern India by 23 species including *H. greenii* W. W. Smith (1911) from Bhutan and *H. wardii* Fischer from Delei valley, N.E.F.A.

It appears that compactness or looseness of the spike, shape and breadth of the bract, nature of the lip and redness or otherwise of the colour of the flowers, are more reliable taxonomic characters than the pubescent nature of the under surface of the leaves and the relative lengths of the stamen and the lip, the characters used by earlier workers in preparing key for various species of *Hedychium*. Accordingly, this paper re-evaluates the various morphological characters of taxonomic interest, suggests recognition of only 16 species in Eastern India within the limits of 19 species studied, proposes a key for easy recognition of these species and presennts an enumeration of the species together with field data on the habit and habitat of each species.

It seems that the edges of the tropical and subtropical evergreen forests provide "natural home" for the genue *Hedychium*, altough *H. aurantiacum* and *H. densiflorum* ascend higher to temperate altitudes in Nepal, Sikkim and N.E.F.A. *H. aureum*, *H. gratum*, *H. greenii*, *H. hookeri* and *H. marginatum* turn up as endemics to Eastern India.

Considering the great range of morphological intergrades together with discovery of various cytological types within *H. coronarium* complex and *H. elwesii*, the latter is treated here merely as another variety of the former species. *Again H. luteum* Herb. Calcut. is presumably based on a single specimen from Nonklow Swamp in Assam collected in 1852. This apparently holotype sheet has the stamen *as long as* but not *half as long again as* the lip and accordingly is identified as *H. coronarium* by Clarke. Hence *H. luteum* is considered merely as a biotype of the variable species *H. coronarium*. Finally, the morphological similarities between *H. griffithianum* Wall. from Khasi Hills and *H. venustum* Wight from Nilgheri and subsequent discovery of the latter species in Khasi Hills, suggest the merger of *H. griffithianum* Wall. (1853) in *H. venustum* Wight (1853).

173. Vegetation of Suhagi Ghats and Chachai Hills (Rewa Hills).

S. C. PANDEYA, J. S. SINGH, D. M. VERMA and B. S. AHUJA, Allahabad.

Rewa Hills are composed of Vindhyan sandstones. Due to weathering the periphery of the main plateau has been dissected into a series of low hills and valleys. Hills are conical and mostly not too sharp.

Climate of the area is hot with average total rainfall of 40 inches. Summers are very hot and dry and monsoon usually breaks in the 2nd week of June.

Rocks are well exposed in the area and the soil is thin, coarse and red "morrum". Due to oxidation of the upper surface the rocks look dark brown in colour. The slopes, in particular, and the total area, in general, are quite eroded. History of the area shows that it was previously covered with miscellaneous forests. Now due to intense felling, the vegetation has become very poor with low and sparse trees. Mention may be made here of the work of Richards (1960) who has accounted the absence of thick vegetation in such areas as being due to edapho-climatic conditions. Actually once the area is eroded and vegetation destroyed, the climatic conditions (more especially micro-climate) changes resulting in slowing down the upward plant succession. It is probably due to this phenomenon that the vegetation is poor in the area.

The vegetation is young, sparse and crooked. It is mostly scrubby with grasses filled in between the bushes. The dominant species are young plants of *Lagerstroemia parviflora* and *Anogeissus pendula.* The paper describes in detail the vegetation of Suhagi and Chachai Hills.

174. Phytosociology of Some Sal (*Shorea robusta* Gaertn. f.) forests of Mandla division (Mandhya Pradesh) on basic rocks.

S. C. PANDEYA, Allahabad.

Under certain climatic limits, distribution of Sal (*Shorea robusta* Gaertn. f.) forests has been generally correlated with underlying rock. Crystalline rocks have been assigned as the ones supporting Sal forests whereas basic rocks like besalt (Deccan trap) are shown to be devoid of it. Recently, however, Pandeya and Jain (1960) have observed the occurrence of Sal forests on basic rocks too. The present investigations were, therefore, undertaken to confirm and further the previous observations as also to compare the phytosociological characters of the Sal forests on basalt (deccan trap) and granite in the same locality and under similar conditions of climate.

Two localities of Mändla division were examined by phyto-sociological methods, viz., (1) Motinala (South Mandla Division)—Hills of basalt with small hillocks of granite and its exposures in valleys; Mangli—Hillocks of granite; Khursipar—Surrounding Hills of Basalt; (2) Dindori (North Mandla Division); Sarai—Complete basalt out-crop.

The Sal forests at Mangli (granite) and Khursipar (basalt) and those at Sarai (basalt) and Khursipar (basalt) have been compared statistically by (F×C) index community coefficient of the author (1961). The forests at Motinala are under mild grazing.

When the community composition of the Sal forests on basalt and granite at Motinala is compared the similarity works out to 89·7 where the forests on basalt at Motinala and that at Sarai (Border) have a similarity of only 72·7.

From these statistical comparisons it is concluded that :—

1. Under certain climatic limits *Shorea robusta* forests grow well on basic rocks like basalt.
2. Under similar conditions of climate and biotic influence the forests are largely similar even on different lithology like basalt and granite, in the present case.
3. Slight variation in any of the factors of climate or intensity of biotic operation changes the vegetation even on the same lithology.

175. Record of the Forest Plants around Bolangir.

H. PATTNAIK, Cuttack; P. C. TRIPATHY, Bolangir; M. MISRA, Cuttack.

Bolangir is an ex-state area of Orissa and is situated on its south-west part. It has an extreme climate and the area is ringed by chains of mountains. The plain has Black Cotton Soil. A record of the forest flora is described which contain about 109 species in 35 families. It is interesting to find the growth of Sal and Teak in this belt as it is the terminal part of Teak and Salt belts of central India. The species like *Feronia, Soymida, Zizyphus, Butea, Randia, Terminalia,* *Gardenia*, *Wendlandia* and *Nyctanthes* are the true ecotypes of the Black Cotton Soil. Besides the account of some of the most economic plants are also named among which *Diospyrus melonoxylon* (Kendu) occurs in the locality in profusion.

176. Contribution to the Flora of moist deciduous and evergreen forests in Shimoga District (Mysore State).

R. S. RAGHAVAN, Poona.

The paper deals with the types of vegetation met with in the evergreen semi-green and moist deciduous forests of Agumbe, Thirthahalli and Sacrebyle ranges of Shimoga District in Mysore State. The forests explored lie between 75° to 75·8′E and between 13″30′ to 13·45′N and are situated at a distance of 10 to 90 kilometres from Shimoga proper. The altitude ranges from 300 m. to 800 m. and the rainfall varies from 200 cms. at Gajanoor to as high as 750 cms. at Agumbe, which because of its peculiar topography receives the maximum rainfall.

The dominant trees in the moist deciduous forests of Sacrebyle range are *Xylia xylocarpa*, *Dalbergia lanceolaria*, *Anogeissus latifolia*, *Salmalia malabarica*, *Kydia calycina*, *Schleichera oleosa*, *Adina cordifolia*, *Hymenodictyon exelsum*, *Pterocarpus marsupium*, *Meiogyne pannosa*, *Wrightia tinctoria* and species of *Terminalia*. As the elevation increases, the thick bamboo forests are replaced by palms and evergreen species as *Holigarna ferruginea*, *Gordonia obtusa*, *Alstonia scholaris*, *Glochidion* sp., *Knema attenuata*, *Diospyros* sp., *Hopea parviflora*, *Garcinia* sp. & *Grewia umbellifera* are seen in plenty. The evergreen forests at Agumbe are characterised by *Poeciloneuron indicum*, *Dipterocarpus indicus*, *Mesua ferres*, *Lagerstroemia lanceolata*, *Elaeocarpus tuberculatus*, *Dysoxylum malabaricum*, *Machilus macrantha* and *Aglaia roxburghiana*. Natural regeneration of the evergreen tree species is quite good inside the thick forests, and the forest floor is almost exclusively covered with genera of Zingiberaceae and Liliaceae, besides seedlings of *Murraya koenigii*, *Strobilanthes* sp. and *Clerodendrum infortunatum*. If the forests have not been disturbed too much, *Dillenia pentagyna*, *Knema attenuata*, *Elaeocarpus serratus*, *Lansium anamallayanum*, *Lophopetalum wightianum*, *Litsea wightiana* and *Actinodaphne* sp. are seen in plenty, perhaps forming a preclimax condition that may revert to the evergreen later on. In forests that have been cleared completely, the evergreen forests show a reversion to the deciduous type and only *Careya arborea*, *Randia brandisii*, *Methanthesa rhamnoides* etc. are seen. In barren rocks exposed to wind and constant leaching, *Phoenix humilis*, *Pteris* sp. and *Securinega* alone flourish.

Rourea prainiana, *Vernonia ornata*, *Trichosanthes wallichiana*, *Adenosacme lawii*, *Sauropus androgynus*, *Laportea crenulata* and *Commelina suffruticosa* are some of the new records reported from these forests.

177. Ecological studies of the vegetation of Gingee Reserve Forest, South Arcot District, Madras State.

K. RAMAMURTHY, Coimbatore.

Gingee Reserve Forest is situated in South Arcot District, Madras State at an altitude of ± 120 M. It comes under Tropical Dry Deciduous (Thorny) Forest. The area consists of hillocks and plateaus with seasonal streams, puddles and lakes. The mean annual rainfall is 107·26 cm. The temperature varies from 64·2°F to 101·8°F.

A systematic Ecological survey of the whole area have been made in different seasons and collected 308 species. A floristic list have been prepared in which species are arranged by strata, life-form and leaf-size classes with a distinction between the more and those less important. The synusial list of the floristic composition as shown by the number of species in each family is prepared.

The prepared Biological spectrum of Gingee R.F. shows that the Nanophanerophytes and Microphanerophytes form the dominant and co-dominant life-forms of the scrub communities; Therophytes and Geophytes form the dominant and co-dominant life forms of the ground floor communities.

The following communities were determined after analysing the mantle of vegetation by applying Quadrat Method.

Associations: Dichrostachys-Randia; Mimosa-Randia; Gymosporia-Randia; Dichrostachys-Gymnosporia; Dichrostachys-Mimosa; Dichrostachys-Barleria; Gymnosporia-Securinega; Gymnosporia-Carissa; Steblus-Cystacanthus.

Associes: Indigofera-Borreria; Indigofera-Evolvulus; Indigofera-Oldenlandia; Heteropogon-Heylandia; Ophioglossum-Cyperus; Xyris-Dopatrium; Isoetes-Hysanthus.

They were recorded in the vegetational map by giving special symbols.

178. The Vegetation around Jumnotri (Tehri-Garhwal).

M. A. RAU, Dehra Dun.

The distribution of vegetation in the altitude range 2 to 3300 metres and the vegetational composition of the main *Rhododendron campanulatum—Betula utilis* and *Abies—Betula—Quercus semecarpifolia* forests as observed by the author during a recent plant collection tour in the Jumnotri area of Tehri-Garhwal Himalayas are described. An interesting association of *Paeonia emodii—Aconitum lycoctonum* was met with at 2000 metres on the way to Jumnotri. The paper includes an enumeration of the angiospermous species collected during the tour and a note on their economic importance. The paper is supported by colour transparencies of characteristic vegetational zones and individual species of interest.

179. A contribution to the Vascular Flora of Vedharanyam and Talaignayar Reserve Forests.

K. M. SEBASTINE and J. L. ELLIS, Coimbatore.

The Vedharanyam and Talaignayar Reserve Forests, situated on the coast of Bay of Bengal, were botanically unexplored. Two botanical explorations were conducted during 1960-61.

The vegetation of Vedharanyam is a South Indian Dry Evergreen type showing gradual change from grassy and swampy types on the coast to a stunted dry evergreen type formed by trees with short boles and spreading crowns. Sea-shore vegetation is dominated by *Spinifex littoreus, Pandanus tectorius, Sopubia delphinifolia, Phyla rodiflora, Pedalium murex, Blumea obliquea, Salicornia brachiata, Suadeda monoica, S. nudiflora* and *Arthrocnemum indicum.*

The Dry Evergreen type forms the major portion and it is characterized by *Mimusops elengi, M. hexandra, Hemicyclia sepiaria, Walsura piscidia, Memycelon edule, Plecospermum spinosum, Hugonia mystax.* The ephemeral aquatic herbs seen are *Limnophila gratioloides, Ludwigia parviflora* and *Nesaea lanceolata.* The epiphytic species, *Viscum orientale, Dendrophthoe falcata, Cassytha filiformis* and *Vanda tessellata* occur. The mangrove species in the forest are *Aegiceras corniculatum, Avicennia alba* and *Excoecaria agallocha.*

Talaignayar Forest is formed by salt-marsh vegetation having extensive growth of species of *Suaeda, Rhizophora candelaria, Aegiceras corniculatum* and *Acanthus* *ilicifolius*. Fresh water aquatic plants like *Najas graminea, Ottelia alismoides* and *Aponogetor natans* are also seen.

210 species were collected and deposited in the Regional Herbarium, Coimbatore. Major families with number of species represented are as follows : Euphorbiaceae, 16; Rubiaceae, 11; Gramineae, 11; Cyperaceae, 11; and Acanthaceae, 10.

180. A Further Contribution to the Flora of Kannikatti Forest, Tirunelveli District.

K. M. SEBASTINE and T. L. SAROJA, Coimbatore.

The Kannikatti Reserve Forest, Madras State is bontanically an under-explored area. Three seasonal explorations were carried out during 1959-60.

The mountain slopes reaching on altitude of 830 m. show the scrub jungle, the dry deciduous and the moist evergreen types of forests. The scrub jungle characterised by *Acalypha alnifolia, A. indica, Caralluma attenuata, Gmelina asiatica, Hugonia mystax*, species of *Securinega*, and *Zizyphus* occurs below an altitude of 150 m.

Between 200 m. and 400 m. the vegetation presents species of *Biophytum, Cipadessa baccifera, Emblica officinalis, Gouania microcarpa, Hibiscus platanifolius, Homalium travancoricum* and *Terminalia catappa* forming the dry deciduous type.

Above 400 m. the moist evergreen vegetation presents gigantic trees with undergrowths of various habits such as *Anoechtochilus elatior, Goleus malabaricus, Dioscorea pentaphylla, Impatiens grandis, Sonerila tinnevelliensis* and Pteridophytes such as *Angiopteris evecta, Cheilanthes mysorensis, Cyclosorus parasiticus, Diplazium latifolium* and *Lastea aristata.*

Economically important plants, *Santalum album, Cymbopogon flexuosus, Hopea parviflora, Balanocarpus utilis, Tectona grandis, Coscinium fenestratum, Elettaria cardamomum* and *Ochlandra travancorica* are found in abundance.

521 species are collected from this region and deposited in the Regional Herbarium at Coimbatore. The enumeration consists only of those not previously reported for Kannikatti, of which three are endemic and ten exotic species.

181. Studies on the ecology and vegetation of the interior parts of Barmer and Jaisalmer Districts in Rajasthan.

SESHAGIRI RAO ROLLA and K. C. KANODIA, Poona.

The present paper gives interesting aspects of vegetation, studied along the interior parts of Western Rajasthan on Indian border covering the surroundings of Sinadari, Bundha, Khuyala, Kchhadi, Ludrawa villages with a rainfall below 15 cms. which were not worked out by earlier workers.

The area under study is divided into four distinct types :—

1. Low rocky hills and gravel mounds—in the surroundings of Barmer with *Commiphora-Grewia-Salvadora-Euphorbia-Zizyphus* association, of Jaisalmer with small communities of *Lepidagathis trinervis-Barleria scanthoides*, and of Ramgarh on way to Khuyala with *Bonamia latifolia* as the dominant component of the vegetation mixed with *Corchorus depressus, Dactyloctenieum aegytium* etc.
2. Sand dunes and sandy plains—around Sinadari and Sheo with *Prosopis-Capparis-Zizyphus-Calotropis* association on sandy plains, around Khuyala with *Panicum-Calligonum-Aerva-Leptadenia* association on typical sand dunes. Beyond Bundha the sand dunes are distinctly covered by the dominant species of *Tephrosia* mixed with *Aerva*. Around Kuchhadi *Dipterygium glaucum* is the most common species mixed with *Crotalaria, Fagonia, Aerva* and *Cenchrus* along the base of the barren and unsettled sand dunes.

3. Saline plains which occupy a considerable area at Daiyyala ka Bundha on way to Ramgarh with *Aeluropus lagopoïdes, Cressa cretica, Sporobolus tremulus, Dichanthium annulatum* and between Baprasar-Ramgarh and Khuyala-Bundha with dominant growth of *Haloxylon salicornioum* mixed with stumps of *Panioum turgidum* and sparse growth of *Zizyphus* and *Capparis.*
4. Tank and River bed areas—around Sheo, Barmer, Sinadari and Amarsagar with interesting species of *Najas, Hydrilla, Marsilea, Scirpus* and others in the watery areas of Sheo tank, species of *Polygonum, Glinus, Heliotropium, Trianthema* in the dried up pond beds at Barmer and Amarsagar and species of *Arnebia, Alhagi, Fagonia, Bergia, Portulaca* and others along the dried river bed at Sinadari.

The details of the various plant communities in different types of habitat noted above are enumerated in the paper.

182. A contribution to the Flora of Gujarat.

SESHAGIRI RAO ROLLA and ANSARI M. Y., Poona.

Various aspects of the flora of Saurashtra region of Gujarat State have been discussed in the paper. A few interesting species such as *Fuirena uncinata* Kunth, *Cyperus pumilus* Linn., *C. difformis* Linn., *C. arenarius* Retz., *Fimbristylis spathacea* Roth., *F. tenera* R. & S., *Eleocharis atropurpures* Kunth, *Scirpus maritimus* Linn., *Commelina kurzii* Clke., *Cyanotis fasciculata* Schult. f., *C. cucullata* Kunth, *Sporobolus coromandelianus* Link., *Periploca aphylla* Donc., *Mollugo nudicaulis* Lamb., and *Urginea wightiana* Hk. f., have been recorded for the first time in this region.

Notes on different types of vegetations namely—(1) Mangrove and sandy coastal vegetation, (2) Meadows and grasslands, (3) Dry scrub forest and (4) Deciduous forest, together with their chief components are also added to the paper.

183. Vegetation of Bharatpur (Rajathan).

SHANTI SARUP, Bharatpur.

Bharatpur connects the Gangetic plain to the Rajasthan. Studies in the vegetation of such an area are quite interesting from many points of view.

The vegetation of Bharatpur may be termed as luxuriant. The rainfall is sufficient. It is a low lying area and many marshy areas exist. Quite ideal places exist for the growth and development of water plants which have been treated separately.

There is, however salt in the soil and the flooding of the terrain in the rainy season to surcharge the soil with water for winter crops without irrigation, brings the salt to the upper layers. Some decades back salt extraction was flourishing industry of the area.

The main vegetation is xcrophytic in character, common plants being *Prosopis specigora, Acacia Arabica* and other Acacias, a number of Asclepiadaceao, *Capparis aphylla,* specios of *Tamarix, Trifolium* etc.

Zizyphus is common and comes up as a persistant weed and left to itself it will form a scrub-climax in a few years. Grasses are common. The whole country side is dominated by *Athagi Marorum* just after the winter crops are reaped.

About 500 cpecies have been collected. A preliminary list of species collected is given. The paper will be illustrated by charts and photographs of the plant association of the area.

Bharatpur is an interesting area for the study of the aquatic vegetation. Many hydresoral communities are represented in distinct zones. *Eiohhornia crassipes* Solm, *Hydrilla verticillata* Casp, *Valisnaria spiralis*, Linn, and *Marsilia minuta* form pure associations. *Ipomoea-Limnathemum* association is formed by *Ipomoea aquatica* Forsk, *Ceratophyllum demursum* Linn, *Limnanthemum nymphoides* Linn, *Lemna miner* Linn, *Sagitaria sagitifolia* Linn, is common. About 60 water plants found in Bharatpur have been listed—P 410 Proc : 47th Ind. Sc. Cong. Part III Abstracts 1960 Bombay.

184. Humus Status of some Forest Communities of Bashahr Himalayas.

J. S. SINGH, Allahabad.

Humus is highly important from the standpoint of forest growth and production, controlling to a great extent the physical, chemical and biological properties of the soil. With a view to investigate quantitatively the humus status under different forest communities of Bashahr Himalayas, the studies reported and discussed in the present paper were made during the month of June, 1960.

The data shows that the ratio of total fresh litter/unincorporated humus and humus content of the surface soil is highest under *Quercus semecarpifolia* community. This may show the higher speed of litter decomposition under this community than the pure coniferous ones. As it is often observed that leaves decompose rather rapidly than twigs, etc., the ratio of leaf/twig amongst fresh litter assumes some importance in the decomposition. In the present studies this ratio does not give a clear indication in all the cases except in *Quercus semecarpifolia* community where it assumes the highest value. It may possibly be due to differences in the nature of decomposition of leaves of different species and floristic composition of communities. The presence of broad-leaved species like *Quercus semecarpifolia* and *Rhododendron arboreaum* and abundance of shRrubs like *Indigofera gerandiana* in conifer communities seem to favour the decomposition of coniferous litter as shown by the higher values of ratio of total fresh litter/unincorporated humus and soil humus under *Abies-Picea-Taxus-Quercus* and *Pinus wallichiana* (II) communities.

185. A preliminary study of topographical relationships in the vegetation of afforested Yumuna ravines in Agra.

S. SINHA and K. C. BASU CHAUDHARY, Agra.

Yumuna forms expensive ravines and vast areas of cultivated lands have thus been eroded. During the last ten years the ravines are being afforested and in Agra range *Acacia arabica* has been extensively planted. The undulating topography results in the formation of Ridge Flats, Slopes (Upper and Lower), Ravine Bottom, Submerged areas and Valley Flats and each of these bear characteristic vegetation in adaption to the habitat. Species occurring in each topography have been listed using line transect method and compared. The dominant vegetation is of xerophytic grasses and trees (*Acacia senegal, A. leucophloea, Prosopis fuliflora, P. specigera, Salvadora oleoides, Zizyphus rugosa, Capparis decidua, C. sepiraria*). A total number of 83 species have been reported. Grasses dominate in the ground cover.

Almost all the herbaceous species grow in the wet season and there is little seasonal change in the vegetation. In winter hardly a few species grow and the rainy season flora persists in favourable places.

186. Is it *Lagarosiphon* or *Nechamondra?*

K. SUBRAMANYAM and N. P. BALAKRISHNAN, Calcutta.

In our Indian floras *Nechamandra alternifolia,* a common aquatic herb of Hydrocharitaceae, is described under the genus *Lagarosiphon.* Some authors use the name *Lagarosiphon roxburghii;* others place it under *Lagarosiphon alternifolia.* Hutchinson separates *Nechamandra* from *Lagarosiphon;* in *Mechamandra* the stamens are always 2, without staminodes, and the leaves are alternate; in *Lagarosiphon,* the stamens are 3, sometimes with staminodes and the leaves are either alternate or verticillate. Geographically, *Lagarosiphon* is confined to Tropical and South Africa; *Nechamandra* occurs in E.S. Asia and N.E. Tropical Africa. A careful study of fresh specimens from several localities in India has shown that the Indian specimens of this taxon have only 2 fertile stamens without any staminodes. The Indian plant is therefore *Nechamandra* and not *Lagaorsiphon.* Accordingly the correct name of this plant is *Nechamandra alternifolia* (Roxb.) Thw. This note presents complete synonymy, a detailed description, an illustration and a map showing distribution in India.

187. A preliminary account of the Flora of Sangam Area, Maharashtra State.

K. N. SUBRAMANIAN and SESHAGIRI RAO ROLLA, Poona.

A short account of a botanical tour taken to Sangam area along the Bank of Godavari river, Maharashtra State in November 1960, for botanical exploration by the authors is given in this paper. This area lies about 185 kilometres North-East of Poona along the Poona-Aurangabad Road in between 75°30′—76° E and 19″5′—20° N at an elevation of 800-950 metres. The soil in the river bed is clayey alluvium and in the plains it is gravelly mixed with sand. The rainfall is less than 80 cms. The vegetation in this area can be mainly divided into *Grassland type* along the river banks and *scrub jungle type* in the plains.

The grassland is dominated by *Heteropogon contortus, Apluda varia, Andropogon pumilus, Aristida funiculata, Dinebra retroflex, Bothriochloa kuntzeana* and *Chloris tenella* mixed with herbaceous undergrowth of *Smithia sensitiva, Flaveria contrayerba, Commelina forskalasi* and *Bacopa monnieri.* Root parasites like *Striga densiffora* and *Sopubia delphinifolia* are very common in grasslands.

The scrub jungle is dominated by *Capparis decidua, Balanites roxburghii, Euphorbia tirucalli, Parkinsonia aculeata, Zizyphus maurantiana* and *Acacia arabica* associated with stragglers like *Caesalpinia bonduc* and Climbers like *Cryptostegia grandiflora, Cocculus hirsutus* and *Pentatrophis spiralis.* The common weeds in this dry locality are *Polygala chinensis, Alysicarpus rugosus, Lepidogathis cristata* and grasses like *Dicanthium annulatum* and *Melanocenchris jacquemontii.*

About 147 species belonging to 114 genera and 35 families of which Gramineae, Papilionaceae, Compositae, Amaranthaceae and Acanthaceae are dominant, are enumerated in the paper.

188. Occurrence of Rauwolfia canescens Linn. in Darbhanga District (Bihar).

MAHENDRA THAKUR, Patna.

Rauwolfia canescens Linn. has attracted much attention as a drug resource in our country. It has been found that this species is richer in active principles than *Raulfia serpentina* Benth. which has been well known hitherto for its medicinal value. The medicinal value of *Raulfia serpentina* Benth. lies in the fact that the tuberous roots are rich in alkaloids which are extensively used for various medicinal purposes. These alkaloids are found only in the roots of *Rauwolfia serpentina* Benth. whereas even the leaves are rich in these alkaloids in *Rauwolfia canescens* Linn. Therefore, this species commands much interest, indicating a more advantageous position than *Rauwolfia serpentina* Benth.

While studying the vegetation of Darbhanga District (Bihar), the author came across *Rauwolfia canescens* Linn. growing wild in large number on the sides of railway lines on the dilapidated Garhs of Rajas of ancient days and in the uncared mango orchards. Its occurrence is more common in northern parts of the districts than in the southern parts.

Hence, it is suggested in this note that the whole district of Darbhanga, particularly the northern area, may be best utilised for the extensive cultivation of this species so that commercial exploitation of alkaloids from the different parts of this plant may be possible. It may be mentioned here that there has been no report of this species from this district in any of the published records.

Cytology & Genetics

189. Study of the male gametophyte of higher plants by the use of fluorescence microscopy.

P. N. BHADURI and PRADYOT K. BHANJA, Calcutta.

The cytological constituents of the pollen grains and pollen tubes and the process of spermatogenesis in some higher plants were studied by means of fluorescence microscopy. The use of such fluorochromes as acridine orange, coriphosphine, auramine, berberine sulphate, acid fuchsin etc., under critically controlled hydrogen ion concentration and osmotic pressure, could clearly differentiate the vegetative, generative and sperm cells as well as other protoplasmic contents such as plastid-like bodies, lipid granules and mitochondria.

When using acridine orange, for example, viable pollen grains were either directlyy crushed in a 0·01% solution of the fluorochrome (pH 5·0 to 5·5) or they were previously germinated in sucrose solution with a trace of boric acid, inside moist incubating chambers. Observations and records were made using ultraviolet or blue-violet light with suitably coupled suppression filters. Where the walls of the pollen grains or pollen tubes interfered with the observation of the particular cell component in question, the latter was dissected or pressed out.

Both coloured and black and white photomicrographs were taken in support of the above observations and are presented in the paper.

190. Mutagenic action of Acridine Orange on *Neurospora cassa.*

K. L. CHAUDHURI, Calcutta.

In view of the high affinity of Acridine Orange dye to nucleic acids the genetic effect of the chemical was tested on the Neuspora system by employing the back mutation test. The technique followed consists essentially of plating spores of the Neurospora mutant S4894 in a high concentration on minimal medium. Colonies appearing on such a minimal medium are counted as reverse mutations.

Spores treated with concentrations of 50 μg per ml. and 100 μg per ml for 2, 4, 6 and 8 hours had considerable killing effect. At 6 hours 100 μg per litre treatment there was a drastic killing with the survival at 12·11% level. Some anomaly in the killing effect was observed and this appears to be due to irregular exposure to light during incubation. In another experiment using the concentration of 50 μg per ml. and varying the pH range from 4·8 to 8·8 treatments were given for 2, 4, 6 and 8 hours. A total of 114 reverse mutations were obtained. The maximum number of reverse mutations scored in a particular treated series was 18 as against only 2 in the control. The pH of the chemical solution does not seem to have any effect.

191. Preliminary report on the effect of X-irradiation on Ribonuclease treated cells.

DEEPESH N. DE and ARYA K. BAL, Calcutta.

In an attempt to explore the biochemical changes leading to X-ray damage, irradiation effects on Onion root tip cells were studied after pretreatment with ribonuclease. Three hours pretreatment of ribonuclease (1 mg/ml) preceeding X-ray irradiation (200r) was found to inhibit chromosome breakage, as has been visualised from the formation of micronuclei (0·3 micro-nuclei per hundred cells as compared to 29·5, in control where irradiation was not preceded by ribonuclease treatment and 0·0, where the cells were treated only with ribonuclease).

The radio-protective nature of ribonuclease has been attributed to its ability to impair intracellular deoxyribonuclease activity and the role of deoxyribonuclease in the chain reaction, that follows irradiation, has also been emphasised.

192. The "Sparse White" Mutant—A case of cytoplasmic inheritance in the variety *Karingkappal (N. tabacum).*

D. M. GOPINATH, Rajahmundry.

In the tobacco variety *Karingkappal* (*N. tabacum*) a plant was noticed which was characterised by the presence of small white patches on the leaves. First it was thought to be a somatic mutation but studies revealed that this trait, like the albomaculatus, is transmitted by maternal inheritance. It was only when these mutant plants were used as the female parents that in the progeny the trait was found to have been transmitted but never in the opposite way. This "sparse white" mutant is characteristic in its own way and does not resemble the albomaculatus mutant. In the early seedling stages the character is not discernible but as development proceeds a small speck of white appears, usually starting from the margin of one or more leaves, and spreads to give "sparse white" patches on the leaves. These patches are confined only to the leaves and are never found either on the stem or on the floral parts. Selfed plants and crosses with the mutants as female parents against normal plants always show in the progeny 20-30 per cent. of mutant plants. Indications are that even though all the ovules that are borne on the female mutant plant carry the mutated plasmagene, the expression of the character in the offspring is governed by a complex bio-chemical reaction. The spread of the patches starting initially as a minute speck suggests that the bio-chemical product which disintegrates the chlorophyll and which is governed by the presence of the mutated plasmagene (and perhaps also by other extra nuclear constituents) is capable of permeating from cell to cell and wherever it permeates, it causes white patches on the leaves through disintegration of the chlorophyll.

193. Chromosome studies in Orchidaceae.

P. N. MEHRA and K. S. BAWA, Chandigarh.

This is a continuation work on the Cytology of Orchidaceae. Ninteen species belonging to eleven genera have been worked out from Simla and Narkanda area in the Western Himalayas. The details are as follow.

Name of the plant	Chromosome number	
	n	2n
**Cyperipedium cordigerum* D. Don.	—	20
Orchis latifolia Linn.	20	—
Herminium monorchis R. Br.	—	40
**H. angustifolium* Benth.	20	40
**Habenaria arietina* Hook.	21	—
**H. elisbethae* Duthie	—	42
**H. ensifolia* Lindl.	21	—
H. edgworthi Hooker	21	42
H. intermedia Don.	21	—
**H. pectinata* Don.	21	—
**H. susannae* Don.	21	—
**H. galeandra* Benth	Ca 21	—
Hemipilia cordifolia Lindl.	—	44
**Neottia listeroides* Lindl.	—	40
Epipactis latifolia Swartz.	19	38
**Cephalanthera ensifolia* Rich.	—	34
Goodyera repens R. Br.	15	—
Liparis rostrata Reichb.	14	28
**Calanthe tricarinata* Lindl.	20	

(Species marked * are new reports)

Chromosome number in the genus *Hemipilia* is worked out for the first time. Secondary association of bivalents have been noticed in *Habenaria arietina, H. ensifolia, H. pectinata* and *Orchis latifolia* but their full cytogenetic significance is not yet known. *Habenaria* which is well represented in Western Himalayas have all the species uniformly with n=21. From previous report in two species of 2n=28 it can be inferred that the base number for the genus is 7 and all the *Western Himalayan* species are hexaploid. Himalayan race of *Orchis latifolia* is diploid but tetraploids are previously reported in literature. *Goodyra repens* and *Epipactis latifolia* occur as different cytotypes. The karyotype in *Epipactis latifolia, Neottia listeroides* and *Cephalanthera ensifolia* is asymmetrical. *Cyperipedium cordigerum* and *Calanthe tricarinata* have a symsetrical karyotype. According to nature of tetrad association the species are classified into three groups : (1) with tetrads associated in groups as in *Orchis latifolia, Herminium angustifolium* all the species of *Habenaria, Hemipilia cordifolia, Goodyera repens, Liparis rostrata* and *Calanthe tricarinata;* (2) tetrads free but members of a tetrad adherent and enclosed by a common wall as in *Epipacits latifolia* and *Neottia listeroides;* (3) members of tetrad free from each other as in *Cephalanthera ensifolia.*

194. Cytoplasmic inheritance in an "Albomaculatus" Mutant in the Cigar Tobacco variety *Vellavazhai.*

G. S. MURTY and D. M. GOPINATH, Rajahmundry.

An albomaculatus mutant was discovered in the cigar tobacco variety Vellavazhai. This mutant was characterised by the presence of white, yellow and green patches on the stem, leaf and the floral parts. Studies revealed that this character was cytoplasmic in inheritance. Mutant plants transmitted the albomaculatus character only when used as a female parent and never in the reverse way. It was further observed that the mutated cytoplasmic gene—the plasmagene—was not universally present in all the ovules that were produced by the maternal plant

Thus, the mutant plant when used as the female parent against a normal plant, not all the progeny were albomaculatus plants; the proportion of the abnormal plants varied from 2 to 20 per cent. Studies with a number of crosses with individual flowers having the expression of albomaculatus character in varied degrees (as evidenced by the extent of the patches on either the calyx or the wall of the ovary) showed that the ovules which arose from a mutated sector of the placental wall alone carried the plasmagene and consequently transmitted this trait to the offsprings. It was further observed that in a small percentage of plants showing the abnormality in the early seedling stages, the character was subsequently lost and the mutant seedling grew into a fully normal plant without transmitting the trait to its progeny—whatever way the crosses were made, with either a normal plant or another albomaculatus plant. The details of this cytoplasmic inheritance are discussed in the paper. Evidence from these studies indicates that the plasmagene causes the disintegration of the chlorophyll or prevents the formation of chlorophyll in the cells where it is present.

195. Studies on the cytology of two species of *Phymatodes.*

NIRANJAN PAL, Calcutta.

In *Phymatodes scolopendria* (Burm.) Ching and *P. nigrescens* (Bl.) J. Sm., the chromosome numbers are $n=36$ and $2n=72$. The somatic chromosomes are characterised by the predominant occurrence of subterminal centromeres. The ratio of length of the shortest and longest chromosomes in both species is about 1 : 2·2. The length of the chromosomes ranges from 2·9—6·5 μ in *P. scolopendria* and 2·4—5·2 μ in *P. nigrescens.*

Meiosis is fairly regular in both species. In *P. nigrescens* the tetrad nuclei, in some of the sporangia, fuse together to form large tetraploid nuclei which immediately undergo 'secondary' meiotic division and show much irregularity in this division.

196. Cytological investigations of *Microsorum Punctatum* (L.) Copel. and *M. Musifolium* (Bl.) Ching.

NIRANJAN PAL, Calcutta.

The chromosome number in *Microsorum punctatum* (L.) Copel. and *M. musifolium* (Bl.) Ching are $n=36$ and $2n=72$.

Meiosis is more or less regular. The somatic chromosomes have close range of variation in length (2·9—6·6 μ in *M. punctatum* and 2·9—6·0 μ in *M. musifolium*) and most chromosomes have subterminal centromeres. In *M. punctatum*, there is only one chromosome with nearly median centromere whereas the other species has two pairs with submedian centromeres.

197. Gametogenesis and the factors of sterility in *Russelia Equisetiformis* Schlecht and Cham. and *R. Coccinea* (Linn.) Wetist.

NIRANJAN PAL, Calcutta.

Russelia equisetiformis and *R. coccinea,* as they occur in India are found to be sterile. In a previous communication (Pal, Caryologia, *14* : 141-150, 1961) it has been shown that the meiotic cycle in the anthers of these two taxa is fairly normal. The present work was undertaken to ascertain the cause of sterility in these species.

The succession in the development of the floral organs is sepals, stamens and petals, and carpels. Microsporogenesis and development of the male gametophyte is normal. During development many of the anther tapetum cells become biseriate and a high number of microspores degenerates. The pollen grains are tricolporate and are shed at two-nucleate stage. The development of the female gametophyte follows the Polygonum type but its rate of growth is very slow and by the time the embryo-sac is matured, the corolla with stamens is already shed. Pollination and fertilization cannot take place as the style and stigma also wither away. So sterility in these plants is neither due to any abnormality in the development of the male and female gametophytes nor due to any cytological irregularity. The 'timing unbalance' in the development of the gynoecium seems to be responsible for the phenomenon.

198. Paramutation-like phenomenon affecting Aleurone colour associated with a Pericarp Character in Maize.

N. K. NOTANI and CHANDRA MOULI, Bombay.

A pericarp mutant in maize characterized by the development or red pigmentation around the silk-scar, has been repeatedly collected from the local Bombay markets. On crossing with homozygous coloured aleurone stocks it disclosed an unusual property of inhibiting the aleurone pigmentation : (1) when crossed as the male parent, the resulting kernels are considerably weaker in pigmentation, (2) when mated as the female parent the resultant kernels with a few exceptions are completely colourless. Back-cross to the F_1 with coloured aleurone stock as the recurrent male parent, yielded kernels giving a whole spectrum of aleurone pigmentation ranging from completely coloured to completely colourless. Three hypotheses were considered in explaining the foregoing data : (1) A single partially dominant inhibitor, which when present in two doses (as would be the case when coming through the female parent, the endosperm being a triploid tissue) completely inhibited the aleurone pigmentation and when present in single dose with double dose of aleurone colour factors, giving a partial suppression of the pigmentation, (2) Involvement of a cytoplasmic particle, (3) Occurrence of a paramutation-like phenomenon. From the analysis of the data, it seems that the last hypothesis is the more tenable one.

199. Cytotaxonomic studies in certain species of *Commelina* Linn. in Eastern India.

G. PANIGRAHI and R. V. KAMATHY, Shillong.

The paper presents an enumeration and distribution of nine of the 10 East Indian species collected from parts of Orissa, Bihar, Darjeeling, Assam and N.E.F.A. and records the haploid chromosome numbers of 5 species and a variety cytologically studied by us, as tabulated below :—

Name of species	Locality	n	Remarks
C. diffusa Burm. f. (=*C. nudiflora* of authors).	Digboi, Jorhat and Howrah.	15	
C. sikkimensis Clarke ...	Shillong.	45	Regular meiosis but 60% bad pollen grains, ovary falls off early; no seed setting.
C. benghalensis Linn. ...	Jorhat, Shillong	11	Occasionally 22 univalents at diakinesis, chromosome bridges at anaphase I.
C. paludosa Blume (=*C. obliqua* Buch-Ham).	Digboi, Shillong and Darjeeling.	30	
	Howrah	c. 55	
C. paludosa var. *viscida* Clarke (=*C. obliqua* var. *viscida* Cl.	Shillong, Cherrapunji.	30	Occasionally 2-4 univalents per cell or with 60 univalents at diakinesis.
C. suffruticosa Blume ...	Nongpoh	30	

Thus, the genus *Commelina* appears to be characterised both by aneuploidy and inter- and intra-specific polyploidy based on x=11 and x=15. The finding of different cytological types is utilised to explain the existence of a large number of ecotypes in *C. paludosa* (=*C. obliqua*) complex, in tropical, subtropical and temperate altitudes.

Discovery of both interbivalent connections viz. 2(5)+2(2)+1(1) in *C. nudiflora* and 2(3)+1(2)+3(1) in *C. benghalensis* at diakinesis and inter-univalent connections viz. 2(5)+2(3)+2(2)+2(1); 1(10)+2(6); 1(8)+1(6)+1(1) and 1(9)+1(8)+1(2) together with chromosome bridges involving 1—3 bivalents in *C. benghalensis* at anaphase I, has been utilised to establish the unreliability of inferring basic chromosome numbers of a species or genus from the interbivalent connections or secondary associations at diakinesis or prometaphase (cf. x=4 in *C. benghalensis* Sharma, 1955).

200. The Cytology and inheritance of B chromosomes in Pennisetum typhoides.

J. V. PANTULU, Vizianagram.

The B chromosomes in Pennisetum typhoides differ from the A chromosomes in their smaller size, they are half the size of the shortest A chromosome of the complement. There is variation in the number of B's in the cells of the same root tip. A similar variation in number of B's exists in the pollen mother cells of the same flower and in the same anther also.

At pachytene the B chromosomes show the following structure. The centromere is sub-terminal and on either side of the centromere are heterochromatic blocks. The short arm consists entirely of heterochromatin and in the long arm following the heterochromatic region there is light staining "euchromatic" region with eight chromomeres distributed along its whole length. The B chromosomes do not pair with the A chromosomes. The B's regularly pair among themselves and form trivalents and quadrivalents when present as higher numbers. Non-disjunction at anaphase I in the pollen mother cells was observed in plants with 2, 3 and 4 B chromosomes. Precocious division of B chromosomes was noted at anaphase I. Non-disjunctionn at anaphase I contributes to progeny with smaller and larger number of B's than expected from the number present in the parents. Precocious division of B's at anaphase I, followed by a division at anaphase II results in progeny plants with higher number of B's than expected.

In the progeny of a cross between plants with 0-B and 2B's in addition to the expected I B plants, plants with 2 & 3 B's also appeared. In the progeny of crosses between plants with 2 B's plants with 1 B, 2 B's and 3 B's were realised in addition to the expected 2 B plants.

201. Cytological observations on some grasses from Allahabad and Kotwa in Uttar Pradesh.

R. P. PATIL and KRISHNA GHOSH, Allahabad.

Alloteropsis cimicina Stapf: 18 bivalents occur at diakinesis. There appears to be no previous report. If 9 is the basic number in genus *Alloteropsis, A. cimicina* is a tetraploid.

Eragrostiella brachyphylla Bor: n=18 in PMC squashes. There appears to be no previous report. Sometimes there is a chain quadrivalent at diakinesis. This count indicates the basic number of a 9 in *Eragrostis* sect. *Plagiostachya* (=*Eragrostiella* Bor) in addition to 10.

Brachiaria ramosa Stapf: Metaphase I and diakinesis show 16 bivalents and there is a 16—16 separation at anaphase I. This number does not agree with the previous report by Mulay and Leelamma. Present observations suggest basic number of 8 in addition to 7 and 9 previously proposed for the genus *Brachiaria*.

Paspalidium flavidum A. Camus : At metaphase I there are 9 bivalents. The previous report was n=27 (Raman *et al.*). Thus diploid and polyploid races occur in this species.

Iseilema laxum Hack. : 14 bivalents appear at metaphase I. This agrees with the previous report by Joshi *et al.* At least three chromosome races occur in this species with the basic number of 4.

PMC material for the species of *Alleteropsis*, *Eragrostiella* and *Iseilema* was collected at Kotwa forest plantation, 11 miles south of Mirzapur, and for the other species at Allahabad.

202. Induced changes of husk colour in *Oryza sativa* Linn by radioactive phosphorus.

BALARAM MAJUMDER, Calcutta.

For the induction of mutation in *Oryza sativa* Linn., an autumn paddy, variety Marichbati, was irradiated with Beta rays from radioactive phosphorus (P^{32}). The isotope was used in the form of phosphate ions ($Na_2 HPO_4$) and the initial activities was 15 μc/seed for 24 hours.

In the P_1 generation one aberrant plant S. 1 was isolated that had seven tillers, and the colour of the husk was black in four tillers out of seven and the three remaining tillers had the normal yellow colour of the husk.

In the seedling stage of the P_2 generation, out of 272 seedlings, 200 showed black tillers, a changed colour, and remaining 72 seedlings had green tillers which resembled the parental tiller colour.

Plants with black tillers, on maturity segregated into four types of plants with different combination of husk colours and awn characters. They were as follows, husk colour black and awnless, husk colour black with awn; husk colour yellow with awn; and husk colour yellow without awn (Parental character).

But the seedlings that showed greenish white tiller, on maturity had the parental yellow colour of the husk and behaved as normal.

Further studies on the isolated types are on progress.

203. Induced Vegetative Abnormalities in *Oryza sativa* Linn by Ionising X-rays.

BALARAM MAJUMDER, Calcutta.

One X-ray induced abnormal plant (S. 275) was isolated in the X_2 generation of Marichbati variety, an autumn paddy following exposure of the dry seeds to 75,000 r X-rays. The seeds of the selection S. 275 were maintained up to X_4 generation for multiplication and further observation.

The population raised in the X_4 generation from the selection S. 275 were very strong in vegetative structure against the control plants. Mean height and leaf breadth of the population from S. 275 were lower and narrower respectively than the control population.

Various types of leaf abnormality were noticed in the plants of S. 275. The types of abnormality are as follows. Simple leaf blade, forked leaf blade, union of two equal leaf blades etc.

In all the types of leaf blade there are two mid vein running either parallel side by side close to each other as in the simple leaf, or they run through the mid region of the two different individual leaf blades.

Leaf apex in the population of S. 275 is one as in the simple leaf blade type or two, as in the forked type and fused leaf blade type of equal or un-equal sizes.

Smooth leaf base is absent in the plants of S. 275 as against the presence of smooth leaf base of the control. Also a groove with two ridges containing two parallel veins is present in each leaf bases of the population raised from S. 275 selections.

204. Inheritance studies on a colour mutation in jute.

RABINDRA KRISHNA BASU, Calcutta.

One of the most interesting genetic change induced by ionizing radiations in jute was change of colour of entire plants, when the seeds of three varieties of *Corchorus olitorius* L. viz. *Tall Mutant, Chinsura Green and R. 26* were irradiated with P^{32} beta rays. *Tall Mutant* is a X-ray mutation isolated in the Botany Department, Bose Institute, in the year 1947. In the P_1 generation grown particularly from the variety *R. 26,* a few seedlings developed into plants simulating the colourations of *Tall Mutant* and *Chinsura Green;* the rest appeared as *R. 26.* The plants, which appeared as *Tall Mutant,* when crossed with *R. 26* or when selfed and grown in P_2 generation, segregated into the mutant and the mother line characteristics in the usual monohybrid ratio; while those appeared as *Chinsura Green* bred true in later generations. This new mutation isolated from the P_1 generation in the dominant, heterozygous form has been named as *Tall Mutant II.*

The evidences so far obtained from the F_2 and back cross generations of crosses involving *Tall Mutants, R. 26 and Chinsura Green,* indicate a single factor difference among them and the inheritance of pigmentation in these varieties is controlled by a multiple allelomorphic series.

Tall Mutant II has also been found to be an early flowering type compared to the *Tall Mutant,* but both the mutations are late flowering compared to the mother line *R. 26.* Like many other early flowering types isolated by the present investigator, *Tall Mutant II* has a very long flowering period.

205. On the influence of colchicine on the mitotic behaviour of *Urginea Inicad* Kunth., the Indian squill.

K. RANGASWAMI AYYANGAR, Annamalainagar.

The present work was undertaken with a view to investigate how far the mitotic behaviour of the cell nuclei in *Urginea indica* Kunth., the Indian Squill, reacts to the influence of the plant alkaloid, Colchicine. For this purpose, bulbs of this plant were grown in pots filled with sandy loam and also in glass bottles containing tap water. The root tips which emerged from the bulbs were made to dip in various concentrations of Colchicine in water ranging from 1%—0·00125% for varying periods of time (1 hour to 72 hours).

Broadly speaking, the effects of the chemical on the mitosis can be classified into two categories, namely, lethal and non-lethal. Under the first category, come those cases of cell nuclei which, under the potent influence of the alkaloid (1%, 0·5% and 0·25% for 4 hours, 8 hours and 12 hours respectively) undergo serious narcosis leading eventually to necrosis or death. The nuclei and the chromosomes in such cases look like so many amorphous pycnotic mashes. Under the second catefory with lesser concentrations (0·125%—0·0125%), come those coses of cells in which the chromosomes either exhibit corrosions leading to transverse fragmentation, the numerous chromosomal fragments so formed beings pread out all over the cytoplasm and reminiscent of irradiation effects; or undergo duplication through longitudinal splitting and arrest of anaphasic separation due to the impairment of spindle mechanism. It is already known that one of the causes of evolution of newer life forms is polyploidy resulting in altered hereditary outfit with which the new organisms are able to stabilise themselves in relation to the environment. The karyological changes recorded here would appear to afford a clue as to how this mechanism of organic evolution works in nature.

206. Cytological studies in some *Solanum* species.

B. G. S. RAO, Waltair.

The cytology of *Solanum trilobatum* and *S. torvum* has been studied especially with reference to the morphology of chromosomes at pachytene.

In both species ($2n=24$) the pachytene chromosomes share certain common features such as (i) they are highly differentiated and the heterochromatic regions are present in either side of the conspicuous centromere while the distal parts consist of euchromatic regions, (ii) the total length ranges from a maximum of 45 microns to a minimum of 25 microns and (iii) the single nucleolus organising bivalent present in each species is more or less subterminal with a terminal satellite in its short arm. However, it occupies the 10th position in *S. torvum* whereas in *S. trilobatum* it is the shortest of the complement being the 12th chromosome in the order of length.

On the basis of morphological data gathered, the 12 pachytene bivalents have been identified, described and a key to their identification presented. Besides total length and position of centromere (arm ratio), the characteristic disposition of the heterochromatic regions serve as diagnostic features in identification of individual chromosomes.

Meiosis is regular and normal.

Preliminary studies made in *S. indicum, S. xanthocarpum* and *S. melongena* reveal that in these also the pachytene chromosomes are differentiated and the chromosome complement in each species ($2n=24$) includes a single sub-terminal nucleolus organising bivalent with the satellite terminating the short arm.

207. Cyto-taxonomical studies of the Fern-flora of Parasnath Hill.

R. P. ROY and S. N. PANDEY, Patna.

Cyto-taxonomical studies of the, fern-flora of Parasnath hills have not been done before although this place is very rich in fern vegetation. With a view to have a detailed knowledge of the different genera occurring there a systematic cyto-taxonomical work on the subject has been undertaken in this laboratory.

A preliminary account of the meiotic and mitotic studies in a few species done so far is given here :

Pteris cretica Sw. has been found to be apogamous with $2x=58$. This species produces only 32 well developed spores which come out of an eight celled sporanigium. *Pteris longfolia* L. has been observed to be a tetraploid with $x=58$ and $2x=116$. It is a normal sexually reproducing plant where 64 spores are produced. The third species *Pteris quadriaurita* Retz. is a sexual diploid species showing 29 bivalents in SMC and 58 chromosomes in the somatic tissue.

Tectaria irregularis (Presl.) Copel. (Dictyopteris irreguaris Presl.) has also been cytologically investigated. It shows 40 bivalents and is a sexual diploid species.

Polyplodium longissimum Bl. (*Pleopeltis longissimum Moore*) *showed* 74 chromosomes in its root tip squash and is perhaps a diploid species.

Detailed investigations which are in progress will be published in due course.

TABLE

Sl. No.	Species	x	2x	Remarks
1.	Pteris quadriaurita ...	29	58	Diploid.
2.	Pteris cretica	58	"58"	Diploid (apogam.)
3.	Pteris longifolia	58	116	Tetrapoid.
4.	Tectaria irregularis ...	40	—	Diploid.
5.	Polypodium longissimum ...	—	74	Diploid.

208. Endosperm cytology of *Hopea odorata* and an *Oenothera* species (an introduced cultivated form).

R. P. ROY and R. P. JHA, Patna.

The present report is a continuation of the authors' previous notes on endosperm cytology of other species (Roy and Jha, 1959, 1960). Both these species had nuclear endosperm. Six weeks old endosperm of *Hopea odorata, Roxb.* showed nuclei with 21, 28, 35, 42, 49, 56, 70, 84 and 112 numbers of chromosomes at metaphase. Majority of the nuclei had, however, 21 chromosomes, the triploid number, and a few one with higher numbers. 8 weeks old endosperm of *Oenothera* species had nuclei with 14, 28, 49, 56 and 70 numbers of chromosomes at metaphase. Again in this species also, most of the nuclei had 14 chromosomes i.e., the diploid number, and only a few nuclei had higher numbers. Thus the endosperm which, to begin with, was triploid in *Hopea odorata, Roxb.* and diploid in *Oenothera* sp. became myxoploid as it developed.

In some nuclei at anaphase, in *Oenothera* sp., laggards were seen. Besides this in both the species, endosperm nuclei of greatly variable shapes and sizes with variable numbers of nucleoli were noted. Normal nuclei, polyploid nuclei, dumbel-shaped nuclei and micronuclei, all were found. At early stage of cell wall organisation in *Hopea odorata, Roxb.* variable numbers of nuclei were enclosed in a cell. In some cells there was only one nucleus, in others 2 or 3 or even 4. This may have given rise to polyploidy by fusion of 2 or more endosperm nuclei in a cell. Detailed studies have also been made and will be published elsewhere.

209. Colchicine treated Opuntia.

R. P. ROY and N. C. MISHRA, Patna.

With a view to induce polyploidy in *Opuntia monacantha,* growing phylloclades were treated with varying concentration of colchicine for different hours.

Effective dose was 0·04—0·05% colchicine supplied for about 18 hours resulting in spineless phylloclades, which were otherwise spiny.

When a few of this spineless phylloclades were separately potted, new phylloclades coming from them were also spineless,

Cytological investigations of this new types of phylloclades is in progress.

210. Cytogenetic investigations in Cucurbitaceae.

R. P. ROY and A. R. MISHRA, Patna.

Cytological studies of the following cucurbits, both cultivated and wild, with regard to their chromosome number and meiotic and breeding behaviour have been made :

1.	*Bryonopsis laciniosa*, L.	$2n=24$
2.	*Cephalandra indica*, Naud.	$2n=22+xy$
3.	*Cucumis melo*, L.	$2n=24$
4.	*Cucumis sativus*, L.	$2n=14$
5.	*Trichosanthes cucumerina*, L.	$2n=22$

Meiotic studies at metaphase I showed large P.M.C.s with regular small bivalents. The chiasma frequency was low. Anaphase was normal and so was the tetrad formation. Preparations in carmine gave much better results than those in feulgen. In *Cephalandra* one bivalent was found to be heteromorphic. Seconnary association among bivalents was well marked. *Cucumis melo*, sometimes, showed non-synchronised disjunction at anaphase one.

Some crosses have been successfully made and the genetical work is in progress.

211. Cytological studies in Malpighiaceae.

R. P. ROY and N. C. MISHRA, Patna.

Cytological investigations i.e. chromosome number and miotic behaviour of the following cultivated members of the *Malpighiaceae* have been made.

Galphimia gracilis
Hiptage Madablota
Stigmophyllon littorales

Somatic studies were made from propionocarmine squash preparations of the root tips after proper pretreatment with 8-hydroxyquinolene. Miosis was studied from squash preparations of anthers.

Somatic counts from the following members :

G. gracilis	$2n=24$
H. madablota	$2n=42\text{-}56$
S. littorales	$2n=22$

Meiotic behaviour was irregular in *G. gracilis* and *H. madablota*. In *G. gracilis* 12, 18 and 24 bivalents were seen to be formed.

In *H. madablota*, the number of bivalents varied in different P.M.C.'s and number of univalents and one quadri-valent were regularly seen in each P.M.C. The total number of chromosomes in different P.M.C.'s differed from 42 to 56.

In *S. littorales* 11 bivalents were regularly formed and the subsequent stages were regular.

212. On a Polyploid *Achyranthes bidentata*, Bl. ($2n=84$) in Nature.

R. P. ROY and V. THAKUR, Patna.

Earlier the chromosome number of *Achyranthes bidentata*, Bl. has been reported as $2n=42$ (Sugiura, 1936) and $n=21$ (Roy and Thakur, 1961). Now, in the present paper is recorded an existence of another cytological race with chromosome number $2n=84$. If the basic number as suggested be 7 for the genus, the chromosome number naturally speaks for a high degree of polyploidy (12-ploidy) prevalent in this species bringing the genus on par with *Amaranthus*, *Celosia*, *Gomphrena* and others of the family Amaranthaceae where polyploidy seems to have played an important role in making them effective weeds.

The 84-chromosomed population of *A. bidentata* flourishes in nature with only negligible cytological abnormalities, bearing no effects on pollen-viability and the percentage of seed-set. Multivalents up to 0·5%—1%—both trivalents and tetravalents —are observed during metaphase I of the dividing pollen mother cells but equal distribution of chromosomes to the two poles is ensured in anaphase I. The regular meiotic division suggests a fairly early origin of this polyploid race.

Morphologically, this race is distinguished from the normal diploid one in its lax spikes and smaller, less pointed, obovate leaves with silvery undersurface when mature.

213. Cytological studies in Myrtaceae.

R. P. ROY and R. P. JHA, Patna.

Cytological studies in some myrtaceous species have been made and their account is given below. The following chromosome numbers have been determined for the first time :

Name of the species.	Somatic number (2n)	Gametic number (n)
1. Myrtus communis, Linn. ...		11
2. Psidium guayava, Linn. var. typica.		11
3. Psidium guayava, Linn. var. 'Chinese guava'.	22	
4. Eugenia jambolana, Lamk. (cultivated var.)	55 (Tjio, 1948=44, Bhaduri and Ahmad, 1949=66).	22 (Bhaduri and Ahmad, 1949=33).
5. Eugenia jambolana, Lamk. (wild variety)	33	
6. Eugenia jambos, Linn. ...	33, 44 (Bhaduri and Islam, 1949=46).	22 (Piji, 1934=21, 27). (Bhaduri and Islam, 1949=23).
7. Eugenia javanica, Lamk. ...	33 (Bhaduri and Islam, 1949=45).	22, 33, 44, 55.

In *Psidium guayava*, Linn. var. *'Chinese Guava'*, (a variety with very small leaves), somatic number was found to be 22; and in cultivated variety of *Eugenia jambolana*, Lamk. it was 55 and in wild variety 33. *Eugenia jambos. Linn.* showed 2n number=33 and 44 and *Eugenia javanica, Lamk.* 2n=33.

Meiosis in *Myrtus communis, Linn.* and *Psidium guayava, Linn.* var. *typica* was normal forming regular 11 bivalents with no meiotic irregularities at any stage. In cultivated variety of *Eugenia jambolana, Lamk.* the same anther showed 22 and 33 bivalents and the pairing was normal. But in the wild variety univalents, bivalents and multivalents were seen. In *Eugenia jambos, Linn.* meiosis was quite normal and 22 bivalents were always found. In *Eugenia javanica. Lamk.* again meiosis was very irregular and pairing was never normal. At metaphase I a number of univalents and multivalents along with bivalents were distinctly seen. The total number of chromosomes at metaphase I was found to be 22, 33, 44 or 55. Detailed studies have been made and are going to be published elsewhere.

214. The *Amaranthus gangeticus* –Complex.

R. P. ROY and V. THAKUR, Patna.

The present investigation consists of a comparative study of various characters of the external morphology of different populations of *Amaranthus gangeticus*, Linn.

and, in addition, a preliminary cytological analysis of some sterile and partially sterile plants found in nature.

The characters studied were : (i) leaf-shape, (ii) lamina/petiole ratio, (iii) laminar width/length ratio, (iv) spike form and (v) the pollen sterility and seed-set.

In the reduction division of the pollen mother cells of sterile and partially sterile plants, numerous cytological irregularities, such as presence of univalents, laggards, pentads, etc., were observed.

The characters were all highly variable and so overlapping that no distinct lines of demarcation could separate the specimens adequately. Though taxonomically treated as a single species *A. gangeticus* comprises a wide range of forms, which at one extreme approach *A. viridis*, L. and at the other, *A. polygamus*, L. *A. blitum*, L., *A. oleraceus*, L., *A. tricolor*, L. and *A. Caturus*, Heyne. etc. Unfortunately enough the systematic position of many of the above species is open to controversy.

It appears that *A. gangeticus* has arisen through hybridisation between these very different amaranths and no wonder, sometimes, involving more than two at a time.

215. Cytology of Cyperaceae.

B. R. SHARMA, Chandigarh.

Cytology of the following 12 species of Cyperaceae has been worked out from Chandigarh and Simla area. Previous counts of chromosomes are enclosed within brackets.

No.	Species	Chromosome number		Previous author and year	Place
		n.	2n		
1.	*Pycreus globosus* Reicht (syn. *P. capillaris* Nees)	40	—	—	Chandigarh Simla
2.	*P. pumillus* Linn. (syn. *P. nitens* Nees)	47	—	—	
3.	*P. sanguinolentus* Nees (*Cyperus sanguinolentus* Vahl)	25	—	—	Simla
		(24)	—	Tanaka (1941)	
4.	*Mariscus paniceus* Vahl ...	42	—	—	Simla
5.	*Juncellus laevigatus* Linn. ...	43	—	—	Chandigarh
6.	*Kyllinga squamulata* Vahl ...	54	—	—	Simla
7.	*K. cylinderica*	56	—	—	Simla
8.	*Fimbristylis dichotoma* (Linn.) Vahl	5	10	—	Chandigarh
		—	(10)	Sharma & Bal (1956b)	
9.	*F. complanata* Link var *kransisiana* Hassk	5	—	—	Simla
		(8)	—	Tanaka (1939d)	
10.	*Bulbostylis capillaris* Kunth ...	36	—	—	Simla
		—	(84)	Tanaka (1937)	
11.	*Scirpus supinus* Linn. ...	14	28	—	Chandigarh
		—	(28)	Sharma & Bal (1956b)	
12.	*S. marilimus* Linn. ...	48, 55	—	—	Chandigarh
		—	(ca 104)	Hakansson (1928)	
		—	(80)	Rodrigues (1953)	
		—	(86)	Blackburn (1936)	
		—	(110)	Tanaka (1937)	

Chromosome numbers of 6 species (Nos. 1, 2, 4, 5, 6 and 7) are worked out for the first time. In case of 3 species (Nos. 3, 9 and 10) the present observations are at variance with the reports of previous authors whereas in 2 species (Nos. 8 and 11) these are in conformity with them. *Scirpus maritimus* (No. 12) appears to be a species complex; two haploid numbers are recorded here, i.e. 48 and 55, the former being different from the previous reports whereas the latter agrees with one of them.

Chromosome numbers in the species examined here range from 5 to 56 and form an aneuploid series. Morphological study of these species is being done to find out any possible correlation in the chromosome numbers and their taxonomy.

216. Chromosomal differentiation between *Oryza perennis* and *Oryza sativa.*

S. V. S. SHASTRY and R. N. MISRA, New Delhi.

The study of meiosis in the F_1 hybrid, *Oryza sativa* (4n) × *O. perennis* (2n) revealed that in every PMC, 1-12 trivalents occur. While the earlier studies indicate that the chain shaped trivalents are most frequent in antotriploids, the present study of intra-genomic hybrid indicate that the frying-pan shapes are the most frequent, ranging from 1-10 per PMC. This observation was interpreted to mean that the chromosomes of *O. perennis* are segmentally homologous to those of *O. sativa.* The shapes of quadrivalents and hexavalents were confirmatory to the above interpretation. Further, some trivalents were ring shaped while some pentavalents were dumpbell shaped (○ – ○), which indicate the secondary and tertiary trisomic condition of the hybrid for some chromosomal segments. This observation indicates that fairly large translocations involving the chromosomes differentiate the keryotype of the two species, *O. sativa* and *O. perennis.*

217. Karyotypic studies in *Oryza* by pachytene analysis.

S. V. S. SHASTRY, D. C. DAS and K. GOPAKUMAR, New Delhi.

The karyotypes of 4 forms of *Oryza spontanea* and 3 forms *Oryza perennis* Moench. (*O. perennis* var. *barthii, O. perennis* var. *balunga* and a collection from Assam) were studied by pachytene analysis. The bivalents of *O. perennis* are thicker and are uniformly stained with no chromomeric details while those of *O. spontanea* are thinner, and are seriated by macro- and micro-chromomeres along with small darkly stained segments. The karyotypes of two forms of *O. perennis* (var. *barthii* and a collection from Assam) are classified under the group 1 b of Stemmins (1958) while that of the var. *balunga* is classified under the group 2 b. All the four forms of *O. spontanea* are included under the group 2 b. It would be observed that the karyotype of *O. perennis* is more symmetric than that of *O. spontanea.* Further, while the pairing at pachytene was normal in *O. perennis,* various abnormalities like differential segments, loosely paired regions, heteromorphic terminal ends were observed in *O. spontanea.* These abnormalities in *O. spontanea* can be either due to the hybrid origin of this complex group, or due to its out-pollinated nature. Some loosely paired segments were observed at pachytene on *O. perennis* var. *barthii.* The significance of these observations for the interrelationship of these species is discussed.

218. Meiotic studies in some Malvaceous species.

R. P. SINHA, Patna.

The present paper deals with the meiotic studies in three species of two genera of Malvaceous plants. A brief account of the results has been tabulated below—

Name of Plants	Previous reports	Authors	Present finding
1. *Sida acuta*, Burm.	2x/14, 28	Skovsted 1935	28
	18	Roy & Sinha 1961	
2. *S. rhombifolia*, L.	14	Skovsted 1941	14
3. *S. alba*, L.	—	——	14
4. *Hibiscus abolmoschus*, L. ...	72	Skovsted 1935	72

Two different populations in *Sida acuta* have shown two different sets of bivalents. One has shown 9 while the other has shown 14 bivalents suggesting that six and seven may both be regarded as the base numbers in the species in the same way as in *Callirhoe* sps. (Skovsted, 1935). This species might possibly have arisen from two different ancestors. They may be regarded as genetic races of the same species. Karyotype analysis and pollination frequency is under investigation and is expected to yield interesting results. The prostrate variety of *Sida rhombifolia* shows 7 bivalents at MI and their configuration is quite different from previous reports. Transplant experiments have been performed with prostrate and erect varieties and it has been concluded that they are not ecotypes but distinct varieties of the same species. The meiotic studies of the other variety is in progress and it is hoped that phenotypic variation may be related to genotypic distinctness.

Interesting results have been found in *Sida alba*. Morphological concept of the species *Sida spinosa* appears to be in a state of confusion. Some taxonomists regard that this has two varieties—one yellow flowered and the other white flowered. Others like Roxburgh separate them into two distinct species, the former type as *Sida alnifolia* and the later as *Sida alba*. In the expectation that meiotic behaviour of the types may give some clue to the delimitation of species, the present studies in the context was undertaken. *Sida alba* shows 7 normal bivalents which differ from those of *Sida spinosa*. Comparative studies with *S. alnifolia* may further clarify the point.

Seventy two bivalents were seen at MI in *Hibiscus abolmoschus* and the number coincides with the commonly cultivated species *Abolmoschus esculentus*. It was hoped that the comparative studies of the two might throw some light on their interspecific relationship. Another important feature was the bivalents at different stages of separation in the same plate. This appears to be significant. This may perhaps lead to meiotic irregularities. Further investigation in this direction is being pursued.

219. "Reversed Geam" and Female Sterility of *Zea mays* due to the 'Ameiotic' Gene.

S. K. SINHA, Cuttack.

The recessive allele of the 'ameiotic' gene in maize reported by Rhoades and Sinha causes complete male sterility and almost complete female sterility. Occasionally, a few triploid kernels may be found in ameiotic ears. The number of such kernels is variable in different families and may range from 0 to 20 or more. Certain observations suggest the possibility that factors for the "reversed germ" condition may modify the action of the ameiotic gene so as to reduce the degree of female sterility to some extent. The "reversed germ" as found in some varieties of maize like the "Country Gentleman" sweet corn is expressed in two distinctly different ways : (1) The germinal face is oriented towards the base of the ear instead of towards the tip, which is usual. (2) Both the lower and the upper spikelets develop in the ear instead of the usual condition of the development of the upper spikelet only. Considering several types of observation it is postulated that reproductive structures farther removed from the usual site(s) or locus of reproductive development tend to be relatively less affected by the drastic action of the ameiotic gene. Genetic experiments to test this postulation have been planned and are in progress.

220. Histological studies of the X ray induced mutants of Jute. III. Non-shattering pods in *Corchorus Olitorius* L.

SUBIR SEN and S. PAUL, Barrackpore.

Generally there is a 20 to 25% loss of seeds in *Corchorus olitorius* due to shattering of pods, while harvesting for seeds. A non-shattering pod type has been isolated from X-ray irradiated progeny of 70,000r treatment in the X_3 generation of JRO 632. The fruit-wall is characterised by the presence of a fibre bundle capping each dorsal vascular trace and of narrow discontinuous mucilage cannals in the mesocarp at the ridges of the dorsal suture. In the normal non-irradiated plants with shattering pods, however, there is no fibre bundle capping the dorsal vascular trace and the mucilage cannals are large and well developed, running all along the length of the fruit and acting as hinges on absorption of moisture to bring about a loculicidal dehiscence. The fibre strands capping the dorsal vascular strands in the variant possibly counteract the stress of loculicidal dehiscence.

The seven very late flowering morphological variants in the same progeny, are found with small stumpy pods. The fibre bundles capping the dorsal vascular trace of the fruit wall is comparatively large and is continuous laterally with the endocarp which has been transformed into a single layer of stone cells (sclerieds). These fruits resist shattering even on mechanical handling.

221. Cytology of endosperm of *Vicia faba* L.

S. L. TANDON and B. M. KAPOOR, Delhi

The importance of endosperm as the main source of nutrition for the embryo is well known. While a considerable amount of work has been done on the morphology and physiology of this tissue, very little is known about its cytology. The knowledge of the behaviour of nuclei and chromosomes in endosperm is essential to find out the causes of variation in nuclear size and the failure of endosperm which leads to abortion of the embryo.

In *Vicia faba*, the endosperm remains free nuclear throughout the course of its development. It develops a chalazal haustorium as it grows. There is a striking variation in size and shape of nuclei. Giant nuclei, branched nuclei, dumbbell shaped nuclei, highly extended nuclei and micronuclei were commonly observed. In general, the nuclei in the haustorium are bigger than those of the rest of endosperm. The number of nucleoli per nucleus ranged from three to ten. Amitosis and fusion of nuclei were very frequent throughout the course of endosperm development. Mostly two nuclei were found to fuse. In some instances three or even four nuclei were involved in the fusion.

The haploid and diploid chromosome numbers of *Vicia faba* were determined as 6 and 12 respectively. In the beginning most of endosperm nuclei were found to be triploid ($3n = 18$). Later, as the development proceeded, 5-ploid, 7-ploid, 8-ploid and 12-ploid nuclei were observed along with the triploid ones. In addition to the polyploid nuclei, several nuclei showed aneuploid chromosome numbers (19, 20, 21). Stages of endomitosis including diplo-chromosomes were recorded. The existence of 6n and 12n nuclei within the same endosperm suggests the occurrence of endoreduplication. The giant nuclei may, thus, be the result of endopolyploidy. There is no evidence for the occurrence of polyteny in *Vicia faba.*

The presence of multiple bridges, laggards and fragments suggests the operation of breakage-fusion-bridge cycle of McClintock (1941). Our observations show that polyploidy, aneuploidy, nuclear fusion and amitosis have caused variation in the size and shape of nuclei in the endosperm of *Vicia faba.* The cytological abnormalities reported in this paper were probably reseponsible for the failure of endosperm which led to abortion of the embryo ultimately resulting in reduced fertility.

222. Nuclear variation, polyploidy and chromosomal aberrations in the endosperm of *Nothoscordum fragrans* Kunth.

S. L. TANDON and B. M. KAPOOR, Delhi.

The paper deals with the cytological investigations on the endosperm of *Nothoscordum fragrans.* The endosperm remains free nuclear up to 8 days after pollination. The nuclei are normally of large size with clear granular chromatin. Intermixed with these nuclei are present giant nuclei with heterogeneous chromatin content. Various shapes of nuclei like dumbbell shaped, spindle shaped, extended nuclei, lobed nuclei and micronuclei were seen. Among these were also present the nuclei connected with wiry strands representing convincingly the stage of amitosis. After 9 to 10 days when the wall formation commences two or more than two nuclei may be included in a single cell forming binucleate or multinucleate cells. These nuclei later on fused resulting in polyploid ones. The number of nucleoli per nucleus ranged from one to twenty.

The haploid chromosome number of the plant was found to be 9 and 10. The diploid number, as determined from the root tips, is $2n = 19$. Obviously there could be two types of pollen grains, some having $n = 10$ and others $n = 9$. Depending upon the type of male gamete fusing with the polar nuclei, various chromosome numbers like 27, 28, 29 and 30 are expected in the endosperm. Of these nuclei with $3n = 27$, 29 and 30 have been encountered. Morphologically the chromosomes are extremely large with median and subterminal centromeres. They were V- or rod shaped depending upon the location of centromere. During the later stages of development, hexaploid, octoploid and even higher polid nuclei were encountered. The occurrence of hexaploid nuclei with diplochromosomes suggests the existence of endopolyploidy. One of the causes for the formation of giant nuclei was, thus, found to be endomitosis. In no case did we find a polytenic nucleus. Aneuploid nuclei were also recorded. The frequency of the occurrence of these nuclei was, however, very low.

Of the many derangements of mitosis may be mentioned the anaphases with multiple bridges, laggards, fragments and chromosome breakages. The occurrence of such abnormalities indicates the functioning of breakage-fusion-bridge cycle of McClintock. These aberrations may also be responsible for the low seed setting of the plant (87 per cent). Details of the cytology of endosperm in relation to its exact age are being worked out.

223. Fasciation in *Achyranthes aspera* L.—A Mutation.

V. THAKUR, Patna.

The phenomenon of fasciation is hereby described in *Achyranthes aspera,* L. The main or the middle inflorescence, which is usually affected, becomes flattened or ribbon-shaped at its tip bearing sterile flowers in the same fashion as is seen in *Celosia cristata*, Linn. The appearance of fasciation in a definite manner and absence of any pathological sign indicate that it is due to gene mutation; for, also, there is no difference in chromosome number or otherwise from the normal one. Fasciated *A. aspera* plants are not frequent in nature for they are not in cultivation and they are eliminated in wild due to production of insufficient amount of seeds. Fasciation has also been reported in *Amaranthus speciosus*, L. Thus it is observed that the family Amaranthaceae contains many closely related genera having parallel heritable variations.

224. Cytological studies in *Solanum nigrum* complex. I. Pachytene chromosome morphology and meiosis in diploid *Solanum nigrum* L.

J. VENKATESWARLU and P. V. BHIRAVAMURTY, Waltair.

A detailed study of the chromosome morphology at pachytene in diploid form of *Solanum nigram* (2n=24) growing as a common weed in India has been undertaken for a better understanding of the interrelationships of the members of the *Solanum nigrum* 'complex5. The twelve bivalents at pachytene have been identified individually on the basis of (i) length, (ii) arm ratio and (iii) extent of euchromatic and heterochromatic segments on either side of the centromere. Quantitative data on subsequent stages of meiosis have also been gathered and found that meiosis is normal. The pachytene chromosome morphology has beenn compared with the different species of the genus *Solanum* investigated by Gottschalk (1954) and also with that in *S. nodiflorum* Jacq., (2n=24) which is also studied by us. It is concluded that *S. nigrum* seems to be different from *S. nodiflorum* on the basis of morphology of the pachytene chromosomes and that the two species are distinct.

225. Meiosis in diploid and colchicine induced tetraploid *Zebrina Pendula* chnizl., A structural hybrid.

J. VENKATESWARLU and P. NARASIMHA RAO, Waltair.

Detailed study of the various phases of meiosis in diploid *Zebrina pendula* Schnizl. (2n=24), a structural hybrid, has been made. At diakinesis and metaphase 1, chains and rings of 3, 4 and 6 chromosomes are found frequently due to segmental interchange. The maximum associations observed in a cell are two chains of 6 chromosomes each. Not more than two higher associations are formed in any cell. Bridges with and without fragments, irregular distribution at anaphase, laggards, univalents and micronuclei are the abnormalities commonly met with. Pollen sterility is very high. The probable origin of the diploid is discussed. Through colchicine treatment the chromosomes in the above have been doubled and a tetraploid (4n=48) with reference to the structural hybrid is obtained. A study of meiosis in the induced tetraploid has shown only bivalent formation. This has been inferred as due to preferential pairing taking place between completely homologous chromosomes furnished by the duplication of the genome brought about by colchicine.

226. Differentiated chromosomes in morning glory, *Ipomoea Carnea* Jacq.

J. VENKATESWARLU and T. V. RAMANA, Waltair.

Ipomoea carnea belonging to the natural order Convolulaceae has been cytologically studied especially with reference to the morphology of the pachytene chromosomes. The chromosome number of n=15 reported by Rao (1947) is confirmed in the present study.

All the pachytene chromosomes are characterised by being differentiated into heterochromatic and euchromatic regions, the former occupying the adjacent regions on either side of the centromere while the latter occupy the more distal regions of the chromosomes. The individual chromosomes can be readily identified at this stage on the basis of their length, position of centromere (arm ratio) and the extent of distribution of the hetero- and euchromatic regions on the respective chromosomes. A key to the diagnostic morphological features of the 15 pachytene bivalents has been made on the basis of data collected from a complete analysis of 10 nuclei, in each of which the individual chromosomes could be identified. One of the bivalents is seen in association with the nucleolus with a terminal or nearly terminal nucleolus organising body. The longest chromosome of the complement measures 67 microns and the shortest measures 36 microns on an average. All the chromosomes are submedian or nearly so.

There is a localisation of the chiasmata in the euchromatic regions and the average chiasma frequency comes to 17·5 per nucleus at diakinesis. Metaphase I could not be analysed due to inordinate clumping of the bivalents on the equatorial plate. Anaphase I and telophase I and second division of meiosis are quite normal and regular.

227. Cytological studies in *Euchlæna mexicana* schrad. (Annual teosinte).

J. VENKATESWARLU and T. V. RAMANA, Waltair.

A locally grown strain of *Euchlaena mexicana,* raised in the Government Dairy Farm for fodder purposes, is cytologically studied with respect to the morphology of pachytene chromosomes, meiosis and somatic karyotype.

On the basis of morphological data collected quantitatively the ten pachytene bivalents which are characterised by their length, position of centromere and knobs, have been identified and a key to their diagnostic features is presented. The longest and shortest chromosomes of the complement measure 89·6 microns and 32·6 microns respecetively. All the chromosome arms except the short arms of chromosomes 6 and 10 have terminal knobs. The knob on the short arm of chromosome 7 is wedge shaped while that in the short arm of chromosome 8 is elongated and these two knob types are recorded for the first time. The 6th chromosome, arranged in the descending order of length, is the nucleolus organising chromosome and has a nearly terminal satellite in its short arm. Except chromosome 5 which is median, all the rest are submedian or subterminal.

A complete analysis of 60 diakinetic nuclei showed the average chiasma frequency to be 20·3 per nucleus with a terminalisation co-efficient of 0·39. Further stages of meiosis are normal and regular.

The arm ratios obtaining at the pachytene are reflected in the somatic chromosome pairs, one of which (sixth) is clearly satellited. The longest somatic chromosome measures 9·13 microns and the shortest 1·43 microns.

Longley (1937) investigated the pachytene chromosomes of seven American strains of annual teosinte and reported occurrence of internal knobs on the basis of which he suggested gross chromosomal admixture of teosintes studied by him, with maize. In the material investigated here, besides differences in chromosome lengths, internal knobs are found to be conspicuously absent.

228. Pachytene chromosome morphology and affinities of *Nicandra physaloides* var. *Immaculata* (L) Gaertn.

J. VENKATESWARLU and B. G. S. RAO, Waltair.

The ten pachytene bivalents of *Nicandra physaloides,* var. *immaculata* have been identified, described and a key to their identification has been made on the basis of morphological data collected quantitatively. All the chromosomes are characterised by being differentiated to varying extents into euchromatic and heterochromatic regions which facilitate easy identification of the individual chromosomes of the complement.

The isochromosome pair with satellites on either arm reported by Darlington and Janaki Ammal (1945) in materials investigated by them is not met with in our material and only a single nucleolus organising bivalent is included in the complement. In 1954, Gottschalk investigated the morphology of pachytene chromosomes in *Nicandra physaloides* and of the nine chromosome types reported by him, six are common with those of the present investigation in their basic pattern. This suggests that probably there is variation in the morphology of pachytene chromosomes in the different varieties of the genus.

Synopsis and disjunction at the respective meiotic stages are normal and regular, resulting in four haploid microspores.

On the basis of similarities of the pachytene chromosomes, *Nicandra* seems to be more nearly related to *Lycopersicum* than to other genera of the family Solanaceae.

229. Meiosis in *Sorghum morgaritiferum* stapf.

J. VENKATESWARLU and V. R. K. REDDI, Waltair.

A study of the morphology of pachytene chromosomes of *Sorghum margaritiferum* Stapf. ($2n=20$) shows that there are four homologues for each of the five chromosomes of the complement including a nucleolus organising chromosome characterised by terminal satellite. These form associations of two each or all four of them are involved in an association, pairing taking place between any two of them at a given point. In the latter case, the association shows exchange of partners at one or two places. Consequent upon the formation of appropriate number of chiasmata at the appropriate places, multivalent formation takes place. A detailed and complete analysis of 24 diakinetic nuclei shows that quadrivalent types 11, 15, 17 and 18 are encountered and types 11 and 17 are more frequent. The average quadrivalent frequency varies in different nuclei from 5 down to 2 with average value of 3·71 per nucleus. The average chiasma frequency is found to be 19·71 per nucleus at diakinesis.

On the basis of the high quadrivalent frequency, the numerically unbalanced distribution of the chromosomes at anaphase I, frequent formation of laggards and the associated high amount of pollen sterility, it is suggested that the investigated material is a natural autotetraploid.

MISCELLANEOUS

230. Pharmacognostic studies on the stem barks of *Michelia champaca* Linn.

RAI H. N. CHAUDHURI, Calcutta.

The paper deals with the detailed macroscopical and microscopical studies on the stem bark of *Michelia champaca* Linn. which is one of the important bark drugs of our country. The stem bark is used for various ailments and can also be considered as an excellent substitute for guaiacum. The longitudinal fissures on the outermost layer of the bark which on drying separates like a hard crust and with greyish brown projecting fibres on the fractured surface are the chief diagnostic characters from the macroscopic point of view. The presence of stone cells with large lumen, secretory cells with mucilage and the prismatic and octahedral crystals of calcium oxalate in the cortical and phloem region and the phloem fibres with bluntly pointed ends and with very small lumen, are the chief diagnostic characters from the microscopic point of view by which this bark drug can be easily identified.

231. A Preliminary study on ethnobotany of some parts of Madhya Pradesh.

S. K. JAIN, Allahabad.

The interior remote hilly tracts covered by dense forests and sparsely populated by human habitation are interesting spots for a study of the natural relationship between vegetation and man. Some such locations have been studied in Mandla, Balaghat, Chhindwara and Bastar districts in Madhya Pradesh.

The plant products i.e. forest produce and the agricultural produce govern the economy of these areas. Several villages are named after their chief plant produce e.g., 'Harragaon' (*Terminalia chebula* Retz.) and 'Raigaon' (*Brassica juncea* Czertn. & Coss.).

These tribal people still practise 'Bewar' system of cultivation though on a much restricted scale. They grow *Cajanus cajan* (L.) Millsp., *Panicum miliare* Lam., *Paspalum scrobiculatum* L., *Pennisetum typhoides* Stapf & Hubb., *Sorghum vulgare* Pers. and *Zea mays* L.

They also raise some vegetables etc. in a small enclosure attached to their houses 'Bari'. *Brassica juncea* Czertn. & Coss., *Capsicum frutescens* L., *Dolichos* spp., *Luffa acutangula* Roxb., *Lycopersicum esculentum* Mill., *Mamordica charantia* L., *Nicotiana tabacum* L. and *Ricinus communis* L. are commonly grown.

These tribals use a variety of wild growing plants for their food and other domestic needs.

Plants used as food are :—Tubers of *Curcuma angustifolia* Roxb., *Dioscorea hispida* Dennst. etc., leaves of *Bauhinia malabarica* Roxb , *B. purpurea* L., *Cassia tora* L., *Centella asiatica* (L.) Urban., *Cordia dichotoma* Forst. f., *Indigofera pulchella* Roxb., *Moringa oleifera* Lam., *Rivea hypocrateriformis* Chois., fruits of *Aegle marmelos* Correa., *Bauhinia* spp., *Boswellia serrata* Forst. f., *Diospyros* sp., *Emblica officinalis* Gaertn., *Ficus glomerata* Roxb., *Gmelina arborea* Roxb.. *Madhuca indica* Gmel., *Mangifera indica* L., *Randia dumetorum* Lamk., *Syzygium cuminii* Skeels..

Bauhinia vahli W. & A. and *Pennisetum alopecurus* Nees are used for cordage. *Cleistanthus collinus* Benth. and *Sphaeranthus indicus* L. are used as fish poison. The inflorescence of *Thysanolaena maxima* Ktze. provides the broom sticks.

A large number of plants are employed for curing disease, some for their medicinal value and others for their supposed magical actions. The area is being further studied.

232. Pharmacognostic Evaluation of the Plant *Asterachantha longifolia* Nees.

P. K. SANYAL and P. N. VARMA, Calcutta.

Asteracantha longifolia Nees (Family Acanthaceae) known as "Kulekhara" in Bengal is an annual spiny herb found throughout Bengal and scattered all over India. It grows up to one meter high in moist and marshy places.

Two varieties were found in plains of West Bengal, having practically the same morphological characters. The only difference which could be observed was the difference in colouration of the flowering tops. When separated into different parts a plant has approximately roots —8·4%, stem 6·5%, flowers 19·6%, leaves 7·0%.

The moisture content, ash content including acid insoluble ash, water soluble ash and sulphated ash were determined. The average moisture content of dried plant was 7·4% and of fresh plant was 74·0%, while the average ash content was 11·5% for both fresh and dried. The extractives of the plant like alcohol soluble extractive, water soluble extractive, chloroform soluble extractive and petroleum ether soluble extractives were determined showing that water soluble extractives were the largest.

The chemical constituents were also determined for the whole plant as well its individual parts like root, stem, leaves and flowers, specially for its content of alkaloids, sugars, polysacchrides and sterols. Though positive reaction of alkaloids were obtained from the fresh plants—no such reactions were obtained from the dried plants kept for more than six months.

A summary of the presence of important chemical constituents from different parts of fresh plants is given below.

Preparations (Fresh plant only)	Alkaloids	Sugars	Poly-saccharides or glucosidal bodies	Sterol
50% Alcohol macerated ext. ...	+ve	+ve	+ve	+ve
95% Alcohol macerated ext. ...	+ve	−ve	−ve	+ve
Decoction (I.P.C. method) ...	−ve	+ve	+ve	−ve
Roots only in 50% alcohol ...	+ve	+ve	?	++
Stems only in 50% alcohol ...	+ve	+ve	+ve	+ve
Flowers only in 50% alcohol ...	−ve	+ve	+ve	+ve
Leaves only in 50% alcohol ...	−ve	+ve	+ve	−ve
Juice of the fresh plant ...	−ve	+ve	+ve	+ve

SECTION OF ZOOLOGY AND ENTOMOLOGY

President :—Dr. L. S. Ramaswami, D.Sc., F.Z.S.

Abstracts.

CYTOLOGY & GENETICS

1. The rate and site of Mitosis in embryonic chick auricle.

N. BEGUM, Calcutta.

The rate and site of the mitotic phenomenon operating in the auricular region of chick during different stages of development have been worked out. The study has revealed that all cells of the cardiogenic field do not undergo division at a time, but there is a sign of distinct mitotic frequency which swings until completion of incubation. Highest rate of mitosis is 8·74% which has been observed in the 19 day embryo, the lowest being 1·38% in the 15 day embryo. Between these two extremities, the mitotic frequency of chick auricular material fluctuates. Though there is no definite mitotic centre, the middle sector of the auricular material happens to be mitotically more active. Comparing the present investigation with the previous study of the ventricular indices by Mookerjee and Begum it is now abuntantly clear that the rate of mitotic activity is much greater in ventricle as a whole. The role of mitosis in the process of individuation has been discussed.

2. Mammalian Chromosomes *in vitro* on the Marker Chromosomes and Chromosomal Polymorphism of Strain L-P 59.

G. K. MANNA, Calcutta.

A sample from the strain L-P 59 obtained through the courtesy of Dr. T. C. Hsu, M.D., Anderson Hospital. University of Texas, Houston, Texas, was studied cytologically and the results have been presented in the paper.

The cell stain had a mysterious origin and a heterogeneous chromosomal constitution. The chromosome numbers vary between 57 and 71 with the mean value of 64·188 chromosomes. The characteristic D-chromosomes in the parental strain L-P 55 were of higher incidence which in the present derivative strain L-P 59 are not only lower in frequency but also have undergone various types of transformations. The cell population has the mean values of 13·84, 2·08, and 47·50 for metacentric, submetacentric and acrocentric chromosomes respectively. The data have further shown that the increase in the acrocentric chromosome number is responsible for the increase in the chromosome number in the complements.

The data have been compared with those of the parental stock and their cell line derivatives, and the importance of chromosomal polymorphism in the evolution of the different caryotypes of different cell strain has been discussed.

3. A Study of the Annual Reproductive Cycle of the Indian Koel, *Endynamis scolopaceus* (Linnaeus) at Varanasi.

C. J. DOMINIC, Varanasi.

The annual reproductive cycle of the Indian Koel, *Endynamis scolopaceus*, a social parasite on two species of crows (*Corvus macrorhynchos* and *C. splendens*) is studied. *C. macrorhynchos* (the jungle crow) breeds during March-April and *C. splendens* (the house crow) breeds during May-June. The peak of the reproductive cycle of the koel lasts from March to June, and this extended breeding season covers the breeding seasons of the two species of crows, in whose nests it deposits its eggs. During the months of March, April, May and June, the testes of the koel usually contain spermatozoa in bundles and also free spermatozoa in the lumina of the seminiferous tubules. The ovary also shows maximum of activity and ova in advanced stages of yolk formation are common during these months. In many individuals, the ovary contains post-ovulatory follicles, showing that ovulation has taken place recently. Some of the larger follicles exhibit bursting atresia, as a result of which yolk globules and phagocytes are present in the ovarian stroma. In a few cases the oviduct contained eggs also. Regression of the gonads set in July, when the contents of the seminiferous tubules in the testes become sloughed off leaving behind only a few rows of spermatogonia. In the ovary most of the remaining larger follicles turn atretic. By September regression of gonads is completed. The gonads remain in the resting condition from October to January. By the second half of January the gonads begin to show signs of recrudescence and at the end of February spermatozoa appear in the testes. In the ovary follicles increase in size rapidly and by the middle of March mature ova are found. Thus the timings of the annual reproductive cycle of the Indian koel corresponds more or less closely to those of its hosts, viz. *C. macrorhynchos* and *C. splendens*. Hence the breeding season of the koel is dependent on an "external proximate cause", *viz.* the nesting periods of the two species of crows already mentioned.

4. On the Motility of Avian Spermatozoa.

P. N. MEHROTRA, Ranchi.

Very few observations have been made on the capacity of independent movement possessed by the spermatozoa of birds or even other vertebrates. An examination of sperms taken from the seminiferous tubules of *Anser anser, Passer domesticus, Copsychus saularis* and *Saxicoloides fulicata,* in physiological saline revealed that they lacked a capacity of independent movement. An identical examination was made of the sperms taken from the epididymal tubules and it was seen that these sperms possess an independent capacity of movement. My observations are, therefore in disagreement with that of Munro (1935) who reported slight motility in the sperms of fowl taken from the testis tubules. The sperms of the birds examined by me did not have any capacity for movement while in the testis tubules.

It was also observed that corresponding to the progressive and reproductive phases of the testis cycle of *Anser anser,* the lining epithelium of epididymal tubules show much secretory activity and the lumina of the epididymal tubules are full of secreted droplets. It seems highly probable that the acquisition of motility by the avian sperms in the epididymis may be due to the action of the epididymal secretion.

5. On the Amitotic Division of Interstitial Cells in the Testes of *Anser anser.*

P. N. MEHROTRA, Ranchi.

The present paper gives an account of amitotic division of the interstitial cells in the testis of *Anser anser.* The process of amitosis as it occurs in the metazoa has been insufficiently investigated and it is hardly known how frequently it occurs and whether it is to be regarded as normal or abnormal. Generally it is believed that amitosis is of rare occurrence and takes place in the cells which are in the early stages of degeneration and are losing their power of division or in the highly specialised cells. Some authors maintain that amitotic division in a nucleus brings about a fatal derangement in them and renders them incapable of further multiplication.

The interstitial cells in the testis of *Anser anser* undergo active division by *amitosis* and *cryptomitosis*, during the progressive phase of the testis cycle in the months of October and November.

During amitotic division of the interstitial cells, the nucleus elongates and a constriction appears in the middle giving it the appearance of a dumbbell which draws into two. The two halves separate and move apart from each other. All the stages of nuclear division can be clearly seen. The cytoplasm then becomes divided between the two daughter nuclei, thus giving rise to two cells. Thus amitotic division of the nucleus should not always be taken as an evidence of degenerative character of the cell. It is resorted to by the interstitial cells probably as a contrivance for their rapid multiplication. I cannot say whether the daughter cells produced by the amitotic division of the interstitial cells in the testis, undergo further division or not. However it is true that the interstitial cells of the testis are highly specialised cells with a limited life, performing their function during a certain period and then losing their activity.

During cryptomitotic division of the interestitial cell nuclei, a spindle is present but distinct chromosomes are not formed. The chromatin becomes concentrated into a mass at the equator of the spindle and divides into two smaller masses which move to the opposite poles.

6. An analysis of the Chromosome Complements in five species of the Indian Spiders belonging to sub-family Lycosinae.

OM PARKASH MITTAL, Chandigarh.

The analysis of chromosome mechanism in five species of the Indian spiders belonging to two genera of the sub-family Lycosinae is presented below in a tabular form :—

TABLE

No.	Species	Diploid number of chromosomes	Number of chromosomes at metaphase I	Number of chromosomes at metaphase II	Sex chromosomes
	Genus *Lycosa*				
1.	*Lycosa chaperi* Simon	22	12	12. 10	XXO-unequal
2.	*Lycosa himalayensis* Gravely	28	15	15. 13	XXO-unequal
3.	*Lycosa madani* Pocock	24	13	13, 11	XXO-unequal
4.	*Lycosa* sp. nov. ..	28	15	15. 13	XXO-unequal
	Genus *Pirata*				
5.	*Pirata latitans* (Blackwall) ..	24	13	13, 11	XXO-unequal

The general course of meiosis is typical and is more or less uniform in all the five species.

All the chromosomes are acrocentric without exception. The two X-chromosomes are unequal in all of them and form a separate accessory plate during metaphase I. Both the X-chromosomes go undivided to one pole during meiosis I, showing precocious movement.

The chiasma frequency is usually low in all the spiders and each bivalent generally carries a single chiasma.

7 . Contributions to the Cytology of Scorpions.

M. R. RAJASEKARASETTY and C. B. VENKATANARASIMHIAH, Mysore.

Preliminary studies on the cytology of the scorpion palamnaeus-gravimanus reveal that the haploid number of chromosomes is 56. Phase-constrast microscopic studies on the spermiogenesis brought out the following points of interest. As found in other scorpions like centrurus and Buthus acute-carinatus the mitochondria do not coalesce and form large mitochondrial ring in *P. gravimanus*. On the contrary they do not fuse till the late spermatid stage when they form the middle piece. 2 sometimes 4 spermatic nuclei are found in a common cytoplasmic mass indicating that at least in some locules cytokinesis does not follow nuclear divisions. However there is a consumation of normal spermiogenesis in these locules. If failure of cytokinesis is attributed to rapid meiotic division, one still has to account for the reason as to why it is so in some divisions and not all. As it is reported elsewhere (Rajasekarasetty 1951 and 1954) even normally fertile males produce morphologically abnormal sperms in *Mus musculus*. It is interesting to note that in *P. gravimanus*, in the spermiogenesis certain anomalies are evident. Broadly two abnormalities can be noted in a few spermatids undergoing spermiogenesis. First is the failure of the spermatid nucleus to move to the future anterior pole before condensation of the nuclear matter begins. This results in the condensation and elongation of the nucleus within the confines of the cytoplasm. The shape of the nucleus is half crescent when it should be long and erect. The second anomaly is the failure of mitochondrial rings to congregate at the posterior end of the sperm nucleus,—two or more may partially attach themselves to form open chains which are scattered in the cytoplasm at a stage when they should have arranged themselves to give a beaded ring appearance. Further in certain locules it was found that while the nucleus has normally transformed into a long filamentions head, the mitochondria are still in a condition comparable to midspermatic stage. Further in some case, only one mitochondrium is attached to the posterior region of the nucleus while the rest of them are sloughed off into the trailing cytoplasm. The anomalies result in middle piece abnormality resulting in atypical sperm formation. The studies on the role of Golgi bodies in spermiogenesis are in progress.

8. Parthenogonic Haploid Embryos in the Grasshopper, *Aiolopus* sp.

S. P. RAY-CHAUDHURI and T. SHARMA, Varanasi.

Virgin females of *Aiolopus* sp. laid 282 eggs. A sample of 41 eggs was dissected on the 13th and 14th day of laying for a study of the chromosomes in the neuroblast cells. Thirteen of them showed no development, twenty five had partial development and only three showed large number of normal neuroblast cells in division. The cells in these embryos were predominantly haploid with some diploid cells, the frequency of the latter varied in different individuals. Out of the remaining 241 eggs only two hatched and both of them were females thus showing that grasshoppers also have *Drosophila* type of sex determination. Cytological evidence of a probable mechanism of the origin of diploid parthenogonic males was found and has been described in the paper.

9. A Study of the Chromosomes of *Notopterus notopterus* (Pallas), Notopteridae.

H. K. SAKSENA, Saugor.

The chromosomal counts made on the spermatogonial metaphase plates of *Notopterus notopterus* for the diploid number reveal 48 chromosomes of different shape and size. The structural difference of chromosomes is well displayed by V, J and rod shapes.

The V's have median attachment but the J's are with sub-median and the rods with terminal attachment. In the rod shaped chromosomes one pair is much smaller than the rest which are more or less of the same size.

The primary and secondary spermatocyte metaphase plate counts reveal that the haploid number is 24. In the primary spermatocytes the bivalents are more conspicuous and take deeper stain than the chromosomes in the spermatogonia. The chromosomes of the secondary spermatocytes appear as small rounded dyads.

The number of cromosome complement of *Notopterus notopterus* (Fam. Notopteridae) is similar to that of *Belone cancila* (Fam. Scombresocidae) both as regards diploid and haploid numbers which are 48 and 24 respectively as well as in the number of V's, J's and r's.

10. Cytological and Cytochemical Studies of the Sexual Cycle of Male Indian Sparrows.

ASIT KUMAR SARKAR, Calcutta.

1. The sexual cycle of Indian house sparrow (*Passer domesticus*) with the seasonal changes in accessory reproductive organs has been studied.
2. The active period ranges from October to July, while August and September are the months of sexual inactivity.
3. Different type of germinal elements have been counted in different months and five histologic stages in testicular cycle have been recorded. The interstitial cells have also been quantitated throughout the cycle.
4. The role of indiscrete mass as well as sertoli cells in the process of sperm release has beenn indicated.
5. The accessory reproductive organs have been thoroughly studied. The accessories undergo a marked seasonal variation histologically.
6. Four cytologically distinct epididymal tubules have been described in the sparrow epididymis. One particular type of epididymal tubules and the seminal vesicle are the storage organs of sperms. The latter is also highly secretory in nature.
7. The localization and distribution of alkaline phosphatase and ascorbic acid in the testicular germinal elements and the former in sex accessories have been reported.
8. Cholesterol is totally absent from the testis. The sudanophilic lipids are present around the sperm bundles which probably act as a nutritive reservoir for the sperms.
9. The staining of the acrosomic system of the spermatid with the PA-Schiff technique beautifully shows the genesis of the head cap in this species.
10. Glycogen and metachromatic substances are very scantily distributed in the whole male reproductive system.
11. The control of testicular cycle in this avian species has been interpreted in the light of modern endocrinological researches. Along with this the probable role of histochemical entities throughout the reproductive cycle has been pointed out and discussed.

11. Effect of Starvation and Dehydration on X-ray induced Chromosomal Non-disjunction in *Drosophila melanogaster*

S. K. SINHA, Cuttack, Orissa.

The effect of starvation on the frequency of x-ray induced non-disjunction of the X chromosome of *Drosophila melanogaster* has been investigated to determine the extent of genetic damage due to irradiation of individuals with subnormal body metabolism. The breeding scheme used for the purpose was suggested by Muller. Virgin flies of the specially synthesized achete (ac^3)—Bar (*B*) stock (*ac*^{3} marking the X chromosome and *B* carried by a small translocated X chromosomal fragment marking the Y chromosome, also attached to another small fragment carrying the normal alleles of ac^3 and *y* for yellow body colour) were either kept on normal media or cut off from food and water for 18 hours. The flies of the two series were next subjected to X-irradiation of 1000r, 2000r and 4000r and mated to male flies of another specially synthesized yellow (*y*)—Bar (B) stock obtained similarly as the ac^3-B one. Non-irradiated flies in both series served as controls for the effect of irradiation.

In the control series (normally fed) the degree of non-disjunction increased progressively though disproportionately with enhanced dosage. In the 'starved' series much higher degree of non-disjunction was observed at 1000r compared with that in the normally fed ones. Surprisingly enough, non-disjunction in the 'starved' series was much lower at 2000r than that of the control series treated with the same dose of x-ray, and non-detectable at 4000r. Besides the evident fact that starvation and dehydration renders the individuals more susceptible to radiation damage, the relationship of dosage to non-disjunction in 'starved' flies is quite interesting. A simultaneous and remarkable decrease in the number of offsprings of the 'starved' series subjected to higher dosage seem to suggest the possibility of simultaneous non-disjunction of more than one chromosome leading to greater chromosomal imbalance and consequent elimination of the non-disjunctional offsprings as the probable cause of such anomaly. The problem of simultaneous non-disjunction of more than one chromosome is being further explored in *Drosophila* as well as in another organism, *Zea mays*.

ECOLOGY

12. Microclimate in the burrow of the Indian desert gerbil, *Mariones hurrianæ* Jerdon.

ISHWAR PRAKASH and C. G. KUMBKARNI, Jodhpur.

Temperature variations inside the burrow of the Indian desert gerbil, *Meriones hurrianae* were observed with the help of Philips rod thermistors and soil moisture temperature bridge. The thermistor was introduced into the burrow by tying it to the tail of the gerbil. As soon as gerbil rested in the burrow, it got rid of the thermistor by biting the thread off. Thermistors were rarely damaged.

Temperature readings were taken at 50, 100 and 150 cms. horizontally deep inside the burrows. On a hot day the temperature inside the burrow was on an average 6·4°C (±1·0°C) lower than the surface temperature while on a rainy day it was about 4·5°C (±0·7°C) lower than the surface temperature at 50 cms. but the temperature was 3·5°C (±1·0°C) higher at 100 and 150 cms. The temperature variations at 150 cms. fluctuate between 0·5°C (±0·3°C).

13. Food consumption and adequate bait for Desert Gerbil control.

ISHWAR PRAKASH and C. G. KUMBKARNI, Jodhpur.

Food consumption of *Meriones hurrianae* Jerdon varies from 4 to 5 gms. in 24 hours. The quantity consumed, however, depends on the quality of food. They did not prefer seed diet in captivity. Seeds of 15 plants (*Tecomella undulata, Prosopis spicigera, Prosopis juxiflora, Zizyphus numularia, Cenchrus setigerus, Cenchrus ciliaris* etc.) growing in gerbil habitat were tried individually and in mixtures. Trials were made on single gerbil and also in groups. Amongst cereals, wheat and millet were most preferred. Wheat flour was also preferred and can be used as a suitable bait for poisoning the Indian desert gerbil, *Meriones hurrianae.*

14. Toxicity, relative acceptance and lethal dose of certain poisons for the Indian desert gerbil, *Meriones hurrianœ* Jerdon.

ISHWAR PRAKASH and C. G. KUMBKARNI, Jodhpur.

Toxicity of various poisons was estimated by oral administration with the help of a hypodermic syringe fitted with a flexible stomach tube. Zinc phosphide is very toxic for *Meriones hurrianae.* An oral dose of 25 mg. in aqueous suspension caused 100% mortality in 3 to 3½ hours. Similarly 50 mg. of Arsenic trioxide killed gerbils in 10-12 hours and 250 mg. of Barium carbonate in 5 to 6 hours.

The relative acceptability (or repellency) of the poisons was measured by the reduction in food intake. There was very little difference in the food intake when Zinc phosphide was administered in concentrations up to 1% of the total bait but at 3%, its acceptability was very low. Arsenic trioxide was unpalatable at 2% concentration but Barium carbonate was readily accepted up to 5% concentration and 10% Barium carbonate was less acceptable. Rodeth and Ratafines were comparatively more acceptable.

The modes of death due to various poisons have been described.

EMBRYOLOGY

15. Seasonal reproductive cycle of the female toad, *Bufo melanosticius* Schneid.

S. L. BASU, Calcutta.

More than three hundred (300) female toads were examined during the period of 1960-61, collected from Calcutta and its suburbs. Body weight, Snout to vent length and weight of both the ovaries were recorded. Some of the ovaries were thoroughly examined morphologically under binocular microscope and others were fixed for proper histological preparations. For convenience they were classified into five different stages according to the predominance of the number of eggs *as per* the following criteria—

Stage I—Small unpigmented ova. Primary Oöcyte in syngenesis. Accumulation of yolk granules round centrosome at one side of the nucleus.

Stage II—Variable pigmentation and small eggs. Chromatin filaments achromatic and nuclei increases in number of fragmentation.

Stage III—Uniform pigmentation, medium sized eggs. Expanded nucleus with saccular nuclear membrane.

Stage IV—Distinction between animal and vegital pole. Medium sized eggs. Dissolution of the nuclear membrane and mixing up of the nuclear material with the cytoplasm.

Stage V—Large eggs with marked pigmentation in the animal pole. Chromosomal mass migrated to animal pole for first polar spindle in primary position.

Post ovulatory ovary was detected mostly during the period of July-August and also during February-March. Ovarian weight rapidly increases during the months of November-December and May-June . The Oögenesis continues throughout the year having the nuclear explosions, yolk accumulations and gradual pigmentation forming the animal and vegital poles. The thickenings, convolutions and well-developed nature of the oviducts depend on the maturity of the ovary as well as the ovulatory season.

The present study further reveals that *Bufo melanostictus* is able to spawn throughout the year. Environmental temperature and humidity seem to be the guiding factor of the reproductive pattern of this common Indian toad. It was noted that the rainy or cloudy days of December caused the rise of humidity and temperature during the winter months which leads to the oviposition of toads in nature. It has also been observed to spawn spontaneously without the presence of males in the laboratory.

16. The development of Cephalic Arteries in *Mastacembelus armatus* (Cuv. & Val.).

HARIHAR NATH BHARGAVA, Saugor.

The development of the cephalic arteries in *Mastacembelus armatus* is studied and described at 5·5 mm., 7·3 mm., 7·5 mm., 8 mm.. 9 mm. and 21·6 mm. length.

The development of aortic arches is studied. The first aortic arch is continuous in the developmental stages studied and represents the mandibular aorta. Its dorsal part represents the secondary afferent pseudobranchial artery of *Gadus* and the orbital artery of other fishes. The secondary afferent hyoidean artery arises as a backward extension of mandibular aorta and joins the ventral aorta. The development of this blood vessel is interesting in *M. armatus*.

The pseudobranch gets its blood supply through the mandibular aorta and is mandibular or spiracular in character. The type of blood supply of the pseudobranch is trigemino-pseudobranchial type of vascularisation. The pseudobranch remains respiratory in function for a long time due to its venous blood supply.

The opercular respiration is present in the larval stages of *M. armatus*.

17. Embryological studies on the connecting tissue of the heart of *Lepus ruficaudatus*.

PREM CHAND JAIN, Bhopal.

Embryology of the connecting tissue of the heart of *Lepus ruficaudatus* has been studied in serial sections. The heart shows the general characteristics of mammalian heart. However, the sinus venosus is present in early stages. Sinuatrial valves are absent while well developed valves are present at the openings of precaval and postcaval veins. In later stages of development the sinus venosus becomes completely incorporated into the right atrium. Sinuatrial node first to appear and its development is independent of the absorption of the sinus venosus. Atrioventricular node is not present in pre-natal hearts but appears only in hearts of new born and adult, in whom it is present as a spherical meshwork of 'Purkinje fibres' at the caudal end of interatrial septum. Multiple muscular atrioventricular connections are absent. Bands of 'Parkinje fibres' are present in the outer wall of the atria in the early stages of development presumably to distribute the contraction stimulus well over the atria. Atrioventricular bundle appears at later stages of development and is not well defined. Sinuatrial node, Atrioventricular node, Atrioventricular bundle, 'Purkinje fibres' and ordinary muscle fibres of the heart form the muscular conducting system of this animal.

18. The development of the Dermal Bones related to Latero-sensory Canals of the head in the fishes, *Ophicephalus pnnctatus* Bloch (Ophicephalidae) and *Wallago attu* Bl. & Schn. (Siluridae).

A. S. KAPOOR, Jodhpur.

The development of the dermal bones related to sensory canals of the head in *O. punctatus* and *W. attu* has been described. Two types of such bones can be distinguished—one, the 'canal bones proper' (*e.g.* the suborbitals), and the other two component type of bones (*e.g.* the frontal) composed of a membranous and a latero-sensory component. The membranous component of the latter type always ossifies far in advance of the latero-sensory component. It always develops in close vicinity of, and immediately below or behind the neuromasts of the lateral lines. The two components of these bones in both the fishes are fused with each other from the beginning. In *W. attu* the latero-sensory component usually develops at the time of invagination of the sensory canal. In *O. punctatus,* on the other hand, it develops only after the canal has attained its full development (except in the case of the preopercle and the posttemporal). There is no disintegration of the connective tissue layer below the neuromasts at the time of ossification of the membranous component, but its dissolution can invariably be observed to coincide with the invagination of the sensory canal.

The main conclusions derived on the basis of these investigations are : Neither the membranous nor the latero-sensory component owes its origin to the morphogenetic activity of the neuromasts; the value of the neuromasts in this respect is limited to that extent only in that they exert some kind of trophic influence for stimulating the ossification in their immediate neighbourhood; the invagination of the canal makes this faculty of the neuromasts much more manifest at the time of formation of the latero-sensory component; the osteoblasts do not have an ectodermal origin and the commonly observed picture suggesting a migration of the osteoblasts from the epithelium to the developing bone is deceptive; the latero-sensory component (as also the 'canal bones proper' which are truly equivalent to the latero-sensory component) in a certain region of the head may be altogether lost with the corresponding loss of the sensory canals of that region, and as such it is justifiable to homologize such bones as for example, the frontal, of the higher vertebrates (which has lost the latero-sensory component) with the same bone in the fishes; it is the intimate fusion of the originally independent latero-sensory component with the underlying bones in early phylogeny which has been responsible for the unquestioned constancy in the course of the various sensory canals through the cranial bones of the present day teleosts, and it is due to an abbreviation of the developmental processes that the ontogeny of these bones in these fishes does not give a complete picture of the phylogeny (*i.e.* one of independent origin and subsequent fusion of the latero-sensory ocmponent with the underlying bone), and the latero-sensory component simply 'grows' out from the fused structure.

19. On the mode of formation of Latero-sensory Canals in *Ophicephalus punctatus* Bloch (Ophicephalidae) and *Wallgo attu* B. & Schn. (Siluridae) and the question of homology between the 'Teleostean' and 'Plagiostomian' Canals.

A. S. KAPOOR, Jodhpur.

The author has described the mode of development of the sensory canals in *O. punctatus* and *W. attu* and has observed that they are formed by a broad epidermal invagination in a manner characteristic for the teleosts. The question of homology between the sensory canals of the teleosts and the elasmobranchs has been discussed in detail and the author has collected evidences to invalidate the contention of Allis (which appears to go without contradiction till this day) that the 'plagiostomian' canal is the result of a dehiscence or deliquescence in the central portion of a solid cord of cells, formed by an involution of the deeper layers only of the ectoderm, while the 'teleostean' canal is the result of a much larger involution which involves the entire ectoderm, and both as such can not be treated as homologous structures. It has been argued by this author that it is not possible to accept the views of Allis on the basis of the following facts : that the very early stages of development of the typical teleostean and typical plagiostomian canals are similar; that in certain teleosts certain or all the canals follow the typical plagiostomian pattern of development, and conversely, certain of the elasmobranchs pursue the typical teleostean development; and finally, in certain teleosts the same canal may sometimes follow the typical plagiostomian and at others the typical teleostean mode of development.

20. On the functional development of right ovaries in certain birds.

P. N. MEHROTRA and K. C. BOSE, Ranchi.

The present paper brings on record the occasional presence of symmetrical, evenly developed and histologically similar paired ovaries in the female reproductive system of the Finchlark, *Eremopteryx grisea*. However only the left oviduct was present in these cases and there was no trace of the right oviduct. The oocytes of the right ovary surrounded by their follicular layers are similar to the follicles of the left ovary. Thus the right ovary is capable of developing to a fully mature condition. The ova produced in the right ovary must be passing out through the left oviduct.

Occasional presence of right ovary has also been reported in the fowl by His (1868), Chappelier ('14), Macklin ('23), Domm ('27), Brode ('28) and Macklin (823); in the pigeons by Riddle ('25); in the domestic ducks by Chappeliar ('14); in the English sparrow by Witshi ('55) and in the falcons by Stieve ('24). Synder ('31) and Stanley ('37) have reported the invariable presence of right ovaries in all the specimens of hawks, *Accipeter nisus* and *Accipeter velox*.

It seems highly probable that the occasional presence of right ovary in some specimens is due to a disturbance in their embryyonic development. As Witschi ('45) has stated, the usual nondevelopment of the right ovary in birds is due to an inherent deficiency in the inductor strength of the right gonad primordium, leading to an asymmetry in the distribution of germ cells to the two sides. It, therefore, follows that in *Eremopteryx grisea* as in other birds where a right ovary is occasionally developed, there is a disturbance in this uneven balance and this results in an equal distribution of germ cells to the two sides; leading to the development of the right ovary. The right oviduct however remains absent.

21. Development of Chondrocranium in the banded Kriat, *Bungarus fasciatus*

JAGADISH PRASAD, Beawar (Rajasthan)

The Chondrocranium of *Bungarus* presents a unique and contradistinctive features unrecorded, hitherto. The enormous basal plate coalesces with the occipital region. Prominent tectum posterius and tectum Synoticum persist. The fissura metotica lies between occipital arches and auditory capsules. The fenestra 'X' invariably exists. There is a solitary pair of hypoglossal foramina. The notochord overrides basicranial fenestra. On Cochlear prominence fenestra vestibuli has been observed. Columella auris extends to quadrate. The trabeculae emerges from the basal plate. A horse-shoe band in a trabecular cartilage arise as separate entity and corresponds with the polar cartilage of Fishes, Reptiles and Birds. The cartilagenous-cum-membranous interorbital septum attribute tropotrabic nature. The Septum nasi is the further extension of interorbital septum rather than trabiculae communis. The Orbitosphenoidal cartilages are persistent. The parietotectal cartilage perpetuates with the laminae orbitonasales merging with septum nasi. The paloto-quadrate comprises quadrate and its counterpart. Meckel's cartilage bears crystalline processsus retroarticularis. Ceratophyals are rod shaped vestigial hypobranchial skeleton.

ENDOCRINOLOGY

22. Occurrence of Thyroid Follicles in the kidney of *Catla catla.*

SURENDER KUMAR AHUJA and MARY CHANDY, Delhi.

The paper deals with the sporadic occurrence of the thyroid follicles in the kidnney of *Catla catla.* They are present not only in the head kidney but in the rest of the mesonephros as well.

The distribution of the follicles is scarce and scattered. Their size and shape are also quite variable. They are smoothly spherical or ovoidal and some being irregular in cross section. The largest follicles measure about 46×42 microns and the smaller one 19×16 microns. The follicles are complete and there is no communication amongst them.

The lumen of the follicles contains the homogeneous eosinophilic staining colloid material. The follicular epithelium consists of delicately built flat cells. The nucleus is narrowly elongated and does not take a very bright stain. The distribution of the cells encapsulating the follicle is rather sparse.

The number of the thyroid follicles is gradually decreased in the posterior part of the kidney, though the size range almost remains the same.

23. Histological and Histochemical studies of the Suprarenal Cortex in Experimentally Hypothyroidised Pigeons.

TAPAN KUMAR BHATTACHARYYA and ASOK GHOSH, Calcutta.

The experimental alterations of the suprarenal cortex in juvenile pigeons following treatment with Methyl-thiouracil is described. The histological picture was supplemented by weight and planimetric studies as well as histochemical methods. A significant atrophy of the adrenocortical masses subject to thiouracil treatment was evident from histologic, histometric and weight studies. This was accompanies by medullary hypertrophy and increase in vascular areas. The atrophy of the histologically undifferentiated interrenal tissue was confined only to the midcortical zone. Simultaneously with cellular atrophy, there was a marked depletion of sudanophilia, cholesterol, phosphatases (acid and alkaline), ascorbic acid, nucleic acids, 'corticosteroids' and carbonyl compounds and a storage of amylase-resistant polysaccharides. Probably this atrophy is mediated through hypothalamo-hypophyseal pathway rather than by direct action of the goitrogen on the adrenal gland. The augmented output of the "G" and/or "M" factors of the TSH from the pituitary in the hypothyroidic state due to thiouracil feeding somehow causes depression in ACTH titre and a resultant adrenocortical atrophy. The histologic and histochemical findings point towards a derailment in cortical function and inhibited corticosteroidogenesis on the part of the adrenals. It is suggested that the atrophic central zone of the adrenal cortex in this avian species is regulated by ACTH titre from the pituitary. A probable participation of this zone in secreting mineralocorticoids has been pointed out and discussed.

24. The structure of adenohypophysis in the Indian fruit bat, *Pteropus giganteus*.

L. S. RAMASWAMI and T. C. ANAND KUMAR, Jodhpur.

We have been interested in the cytochemistry of the gonadotrophs in vertebrates in general. Much work has been done on this aspect in many mammals. Since it became known that the pituitary gonadotrophine are glycoproteins (mucoproteins) (Li & Evans, 1948), Purves and Griesbach (1951) used the PAS technique of Hotchkiss and Mcmanus to identify the gonadotrophs in the rat adenohypophysis. A technique for the tinctorial differentiation of PAS gonadotrophs was developed by Wilson and Ezrin (1954), and later on by Rennels (1956) and Herlant (1956). Adams (1957) was able to show the presence of two types of gonadotrophs depending on the type of PAS positive material present in them. One is labile and the other is resistant to performic acid oxidation. Basophilia in the gonadotrophs has been shown to be due to the presence of RNA (Siegal, 1955).

Nothing is known regarding the nature of the gonadotrophs of the mammals of deserts. In addition to studying these, we have also been studying the cytochemistry of the adenohypophysis of the Indian fruit bat, *Pteropus giganteus* during the various phases of reproduction. Our preliminary findings of the cell types in this bat go to show their overall resemblance to the cell types described in the bat *Myotis myotis* by Herland (1956). However, the evidence at hand enables us to identify the cell types as follows : The large angular PAS purple and Kresofuchsin positive cell as the TSH, the smaller PAS purple cells as the FSH cells and the PAS magenta cells as the LH cells.

We have also used cytochemical techniques developed in recent years with the hope of understanding more about the physiology of the gonadotrophs of the fruit bat during the various phases of reproduction.

25. Seasonal changes in the Thymus and Spleen in relation to the activity of the testes in the Lizard, *Calotes versicolor* (Daud.).

H. B. DEVARAJ SARKAR and M. APPASWAMY RAO, Mysore.

The changes in the thymus and spleen exhibit many unique features. Up to the age of puberty, they grow in relation to the growth of the body, but later their changes depend on the sexual activity. Therefore it was felt that a detailed study of the thymus, spleen and gonads in animals exhibiting sexual periodicity may throw some light on their inter-relationships. *Calotes versicolor* was chosen for this study as it exhibits definite periodicity in its sex cycle.

The breeding season in this lizard extends from May to August and the nonbreeding season runs from September to April. During reproductive phase, the testes are large, with full of sperms (testes weight 524·87 ± 34·99). In the first half of the nonbreeding season (September to December) the testes regress completely (testes weight 39·77 ± 5·5). The tunica albuginia is thick and the seminiferous tubules are lined by highly vacuolated degenerating seminiferous epithelium with exfoliated cells in their lumen. The regressed testses regenerate in the second half of the nonbreeding season (January to April) when they increase in size (testes weight 189·66 ± 25·17) and the seminiferous epithelium proliferates showing increased mitotic and meiotic activities.

Gravimetric and histological changes of the thymus and spleen indicate an intimate relationship with the activity of the testes. At the onset of the breeding season, when there is formation and liberation of sperms in the testes, the involution of the thymus and spleen is initiated. It is suggested that the luteal hormone of the pituitary which stimulates the formation and release of the sperms in the testes, may initiate involution of the thymus and spleen. In the middle of the breeding season (June) when the interstitial cells of the testes are large, the thymus and spleen undergo acute involution. They are reduced in size (Thymus wt. 16·11 ± 0·85, Spleen wt. 16·64 ± 2·31) having degenerating plasmodial masses. This may be due to increased activity of testes and adrenals during this period. In the period of regression, when the testes are inactive the thymus and spleen remain in an involuted condition without any appreciable change in their size (Thymus 10·11 ± 0·10, Spleen 11·94 ± 1·73). However, during the period of regeneration, the thymus and spleen hypertrophy when the regressed testes shows proliferation of the seminiferous epithelium. At the end of this period (April) the thymus and spleen are large and well developed (Thymus 24·47 ± 1·69, Spleen 26·01 ± 3·39), with many thymic unicellular Hassall's corpuscles. It is suggested that the follicle-stimulating hormone of the pituitary which stimulates the seminiferous epithelium of the testes to proliferate, may also cause the regeneration of the thymus and spleen in this lizard.

26. On the extra-pharyngeal disposition of the thyroid follicles in the teleost.

A. G. SATHYANESAN and MISHRI PRASAD, Varanasi.

In the majority of teleosts the thyroid gland is in the form of scattered follicles in the subpharyngeal region among the loose connective tissue in relation to the ventral aorta. Two specimens of *Barbus conchonius* collected from Banaras during August 1961 exhibited thyroid follicles in their kidney. In one there are comparatively fewer follicles scattered throughout the kidney tissue. But in the other such follicles are numerous and their distribution is more restricted to the head kidney. However, few of them were seen sparsely located throughout the kidney, even in the posterior region. All the thyroid follicles were distended with colloid and though enlarged the smaller ones appear to be 'normal'. This problem is being under further investigation.

27. Plumage control in White-throated Munia *(Uroloncha malabarica)*.

R. N. SAXENA and P. D. TEWARY, Varanasi.

Plumage in birds can be under the control of various factors, e.g. hormones, produced by either adenohypophysis, gonad or thyroid or it may be under the control of genetic factors. The White-throated Munia (fam. Ploceidae) is a small bird where sexes are alike, th upper plumage is earthy brown, the upper tail coverts white and the ventral plumage buffy white. The mechanism that controls pigmentation of the plumage in this species has now been studied.

Some adult birds of both sexes were castrated and their feathers studied every month along with the plumage of some normal control birds. The castrated and normal adult males and females always regenerated similar type of plumage throughout the year. The absence of nuptial or eclipse plumage suggests that the plumage colour is independent of the gonad or gonadal hormones, and the possibility of adenohypophyseal control also seems to be out of question, as during eclipse, when the pituitary is inactive and does not produce any gonadotrophins, the bird regenerates the same plumage as in nuptial period when the pituitary produces all the hormones. It seems, therefore, that the plumage in white-throated Munia (*Uroloncha malabarica*) is free from the control of gonads and adenophypophysis and their hormones and probably is fixed by the genetic factors present in gene complex of the species.

28. On the thyroid gland of the genus *Notopterus* (Lacepede).

MADHU SUDAN SHARMA, Delhi.

In the genus *Notopterus*, the thyroid is a well developed, bilobed compact structure lying under the basibranchials. Owing to the extreme lateral compression of the body, the floor of the pharynx is narrow. Consequently, the thyroid gland is confined to the space between the first and second afferent branchial vessels and does not extend anteroposteriorly. The structure presents all the histological features of thyroid—follicles interspersed with thyroid epithelium and connective tissue. The identification of this structure as thyroid has not been reported so far, although it has been described as a sinusoid organ by earlier worker.

29. Seasonal variation in the 'Periodic acid Schiff' positive cells in the pituitary of some Catfishes.

THAKUR PRASAD SINGH and A. G. SATHYANESAN, Varanasi.

The histology of the pituitary of *Mystus vittatus* and *Clarias batrachus* is studied. Of all the components the middle glandular region of adenohypophysis exhibits seasonal variation which are correlated with the gonadial cycles. The histochemical techniques reveal that quantitative and qualitative seasonal changes are convincing in the cyanophils of the above region. Those cyanophils that are stained green or blue by modified trichrome and Mallory's triple stain are PAS positive and take up deep purple colour, while all the other cell types are PAS negative. The PAS positive cyanophils are fewer in number during the prespawning and maturing phases of the gonads. But they form the predominant cell type with granules of varying shape and size during the mature phase. And once again they lose their predominance towards the end of the spawning phase.

During the mature phase, in the middle glandular region of *M. vittatus* two types of acidophils are discernible in the Masson's trichrome stained preparations. They are the intense red Fuchsin Ponceau cells and orange-G cells. These acidophils are also PAS negative. Further work is in progress.

30. Cytochemical study of the Suprarenal Cortex of the pigeon in electrolytic disbalance.

DILIP SINHA and ASOK GHOSH, Calcutta.

Some cytological and cytochemical effects were observed in the adrenal cortex of the pigeon treated with NaCl, KCl and desoxycorticosterone acetate (DCA). As judged by the concentration of alkaline phosphatase and cytological alterations in the midcortical zone of either NaCl or DCA treated birds, it was pointed out this this zone attained a marked atrophic condition. A hypertrophy of this zone to a moderate extent was noted in KCl overdosaged pigeons. It seemed to be obvious that these changes were brought about by an altered Na/K ratio. This suggests a probable participation of midcortical zone in elaboration of 'salt regulating hormones'. However, this hypothesis fails to explain the behaviour of cortical lipids in salt and DCA administered pigeons. The problem of differential response of lipids in our experimental materials has been discussed in the light of a probable adenohypophyseal mechanism controlling adrenocortical lipogenesis.

31. Effect of Thyroxine on Radioiodine Metabolism by the Thyroid Gland of Goldfish, *Carassius auratus*, in fresh and iodine-enriched water.

P. N. SRIVASTAVA, Jodhpur.

Two groups of goldfish, *Carassius auratus* L., were maintained in fresh and iodine-enriched water (60 p.p.m. KI solution) in a constant temperature room at 20°C. for a week. Each fish was then injected with 40 μc carrier-free I^{131}. After 24 hours, the fish in the above groups were sub-divided into two sets, in one of which the fish were injected with 0·4 ml. of 0·1% *l*-thyroxine and in the other with 0·4 ml. of physiological saline which served as controls.

The ratio between the peak values of radioiodine accumulation between physiological saline injected and thyroxine injected is approximately 1 : 3 in iodine-enriched water and 1 : 4 in fresh water. The peak value of thyroxine injected fish in iodine-enriched water is similar to the peak value of physiological saline injected fish in fresh water. Of the values at 144 hours, thyroxine-injected fish retain 9 times more radioiodine than the control, whereas in fresh water, the difference is only 5·5 times. The results suggest that thyroxine inhibits the release of radioiodine from the thyroid.

32. Effect of Thyroid Hormone, Anti-thyroid Drug and Pituitary Extract on Radiophosphorous Metabolism in Thiourea and Radioiodine treated Goldfish, *Carassius auratus* L.

P. N. SRIVASTAVA, Jodhpur.

Goldfish, *Carassius auratus* L., were treated with radioiodine and thiourea. In the former the thyroid follicles were completely destroyed and in the latter they had become hypertrophied and hyperplastic and were devoid of colloid. When they were kept in aquaria with radiophosphorous, their uptake was almost similar to one another and was half of that of the controls.

The uptake of thiourea-treated fish was increased by 40% after acetone-dried goldfish pituitary gland injections whereas in radioiodine treated fish there was no significant change.

Radioiodine-treated fish, when injected with thyroxine increased their uptake by 50% but even then was less than that of the control. When thiourea-treated fish were injected with thyroxine their uptake was restored to the level of that of controls.

The conclusion drawn from the present investigations is that in fishes which lack a parathyroid, the thyroid gland plays a major role in the regulation of phosphorous metabolism.

33. Castration in the male Garden-lizard *(Calotes versicolor).*

J. P. THAPLIYAL, Varanasi.

Accessory and secondary sex characters in lizards, follow closely testicular cycle. This relationship has been studied experimentally in the male garden-lizard (*Calotes versicolor*). A number of adult garden-lizard males were castrated during early progressive phase of their sexual cycle. A group of normal males of similar body weight and gonad size were maintained as controls. The experimental and the control animals were sacrificed during the peak of their cycle. On examination, it was observed that castration leads to reduction in hemi-penes size. Vas deferens and the renal sex segments of the kidney, which were slightly hypertropic at the time castration also regress to the quiescent phase condition.

The hemi-penes of the control animals during the period increased in size, the vas deferens became greatly convoluted and tubules of the renal sex segment of the kidney showed marked secretory hypertrophy.

It, therefore, appears that in this species, for the development and maintenance of the renal sex segment, hemi-penes and male ducts during reproductive phase continued presence of testis is essential and that castration, even if performed during early progressive phase when these organs have partly developed and are further developing will lead to immediate regression of these accessory and secondary sex organs to the non-breeding condition.

ENTOMOLOGY

34. Male Reproductive organs of *Platypleura capitata* (Oliv.) (Cicadidae-Homoptera).

P. V. ANANTHAKRISHNAN, Varanasi.

Each of the paired testes in *Platypleura capitata* (Oliv.) comprises of forty-eight free follicles each of which is related to the vas deferens by means of a vas efferens. Posterior to the insertion of a pair of mesadene accessory glands the vasa deferentia ran caudad to meet the ejaculatory duct which is thick and muscular proximally and tapering distally. Each testicular follicle is covered by an epithelial sheath lacking cellular definition and is filled with mature spermatozoa and granular particles. A vesicula seminalis is absent. The proximal part of the ejaculatory duct has a thick covering of an outer coat of longitudinal muscle fibres and an inner band of circular muscles On the ventral side it bears a diverticulum pressed against the circular muscles. The chitinous intimed of the ejaculatory duct is quite prominent in the basal portion but is reduced to a rim-like lining in the distal part.

35. Internal Reproductive Organs of some Membracidae (Homoptera-Hemiptera).

P. V. ANANTHAKRISHNAN, Varanasi.

The morphology and histology of the male and female reproductive organs of *Oxyrachis tarandus* (Walk.), *Pogon bostigmatus* (Dist.), *Leptocentrus orbitus*

(Dist.) and *Telengana consobrina* (Latr.) are described and illustrated with drawings and microphotographs. A measurable degree of uniformity in the organisational pattern of the male and female reproductive systems in Membracdiae is observed. In the males, each of the paired testes consists of a varying number (8 to 12) of free follicles which are related to the vas deferens by means of short vasa efferentia. The vas deferens in its course is dilated into a short vesicula seminalis posterior to which it receives a mesadene accessory gland. The ejaculatory duct is short and bulbous at the base and tapering towards the distal end. Inside the testicular follicles the germ cells are present in various stages of development in different sections of the follicle giving an appearance of zonation in them. The vas deferens has an outer covering of a few slips of circular muscle fibres, inside which the epithelium bounding the lumen is very thin and without clear cellular differentiation even though nuclei are discernible. The ejaculatory duct has a thick covering of circular muscles and a chitinous intima lining the lumen. The female reproductive system consists of a pair of ovaries, a pair of lateral oviducts, a median common oviduct, a pair of colleterial glands opening into the vagina, and a median long accessory gland also opening into the vagina. Each ovary consists of a varying number (8 to 12) of acrotrophic ovarioles. The proximal part of the median accessory gland is histologically different from the distal part in having a thick coat of circular muscles, a thick intima, and a small lumen; in the distal part the epithelium is made of columnar cells which are vacuolated and charged with secretion, and a muscular covering is absent. The spermatheca is simple in design and structure.

36. Phylogeny of the Auchenorhynchous Homoptera.

P. V. ANANTHAKRISHNAN, Varanasi.

In this paper, the phylogeny of the Auchenorhynchous Homoptera is discussed in the light of the results secured from a study of the morphology and histology of the internal reproductive organs. Due attention has been paid to the works of Dumeril (1806), Osborn (1895), Kirkaldy (1906, 1910), Handlirsh (1908), Taylor (1918), Tillyard (1919), Singh Pruthi (1925), Carpenter (1931), Spooner (1938), Evans (1941, 1946, 1948, 1957) and Kramer (1950). The male and female reproductive systems of Jassidae bear a stronger resemblance to the condition found in the Cercopidae and Membracidae. These three families, therefore, seem to stand together. The male and female reproductive systems of Cicadidae differ from those of Jassidae-Cercopidae-Membracidae and Fulgoroidea to a marked degree. In the female cicada the presence of a bursa copulatrix, not found in the jassoid complex, is a special feature. Further, the close association of the bursa, posterior part of the common oviduct and the stalk of the spermatheca within a common muscular covering mark the female reproductive system of the cicada as unique among the auchenorhynchous Homoptera. The male genital system of the cicada approximates to that of the jassoid group in certain minor details. But the structure of the testicular follicles, long vasa deferentia devoid of vesiculae seminales and the ejaculatory duct provided with thick longitudinal muscles outside a band of circular muscles are characteristic of the cicada and distinguish them from the other families with which we are dealing here. The Fulgoroidea stand apart from the rest of the Auchenorhyncha and even a casual study of the reproductive systems accords a separate position to this group. There is variation *inter se* in the pattern of both the system in Fulgoroidea. The male reproductive system of these Homoptera is characterised by elongated testicular follicles and a common muscular covering of the vasa deferentia beyond the seminal vesicles; and the female reproductive system is unique by reason of the structure of the complex spermatheca, fingershaped glands on the lateral oviduct, a spacious bursa opening into the sac-like gynaetrium, and the digitiform head of the spermatheca. Thus three lines of evolution may be traced in the Auchenorhynchous Homoptera. Cercopidae, Jassidae and Membracidae may be embraced by a single group, the jassoid complex indicating one line of evolution. Cicadidae form the second line. The Fulgoroidea constitute the third line. Illustrative diagrams of the male and female reproductive systems of the five families and two phylogenetic charts are included in the paper.

37. Morphology of the Alimentary Canal and Salivary Glands of *Tessaratoma javanica,* Thunb. (Hemiptera : Pentatomidae).

KARTIK CHANDRA BOSE and AJIT KUMAR SEN, Ranchi.

Tessaratoma javanica, Thunb. is a serious pest of the young shoots and fruits of *Lichi chinensis* (Fam : Sapindacae) one of the important fruit trees of India. The present paper deals with the morphology of the digestive system and salivary gland system of the aforesaid insect.

The study of the digestive system and the salivary gland system in the above mentioned insect reveals the following facts.

The mouthparts show no diversity from the usual Hemipteran type. The mouth is a narrow tubular part situated at the tip of the head. It leads to the pharyngeal pump, which is encased in a heavily chitinised V' shaped part inside the head cavity. The pharyngeal pump is attached from all sides to the inner wall of the 'V' shaped chitinised part by strong sets of muscles, which also operate the pump.

The pharynx in both nymphs and adults is extremely modified to form the pharyngeal pump.

The oesophagus in the first instar nymph is short and more or less translucent but in the adult it is slightly longer and shows a somewhat wide region at about the middle, which is supposed to be the reminiscence of the crop in other insects. The oesophagus joins the mid-gut by invaginating into it. There is no externally visible valve at this region.

The mid-gut owing to the diversity of external structure and probably functionally too, has been divided into four distinctly different regions e.g. the mid-gut I, II, III and IV respectively.

In the case of the first instar nymph, dissected just after the emergence from the egg, it is seen that the mid-gut-I is very large and is filled up with a green coloured liquid food which is probably the embryonic food. The mid-gut II is an imperfectly rounded whitish structure, and the mid-gut III is not well formed. The mid-gut IV is a whitish, coiled tube of uniform diameter. In adults, however, the four divisions of the mid-gut are distinct. The mid-gut-I is a brownish convoluted structure, wide at the anterior and tapering at the posterior end, finally forming a narrow, whitish 'S' shaped tube, which connects the mid-gut I & II. The mid-gut II is a rounded structure closely attached to the posterior end of the mid-gut I. It is filled up with a pasty food matter. The mid-gut III is a bright orange coloured 'U' shaped tube, which is placed normally in a horizontal fashion. Both the ends of this part are tapering. The posterior end of the mid-gut III does not form any specialised connecting tube to connect the mid-gut III with IV. The mid-gut IV is a long, coiled tube of whitish colour and uniform diameter. It joins posteriorly with the hind-gut antero-medially.

The hind gut in both nymphs and adults has been divided into two parts namely Anterior rectum and Posterior rectum. The anterior rectum consists of a more or less transparent saccular structure the rectal sac with two postero-lateral rectal pouches. There are four Malpighian tubules starting laterally from the anterior rectum slightly above the rectal pouches. In the first instar nymph the Malpighian tubules are not very much coiled.

The posterior rectum is a short wide transparent tube starting postero-medially from the anterior rectum. Posteriorly it meets the anal region which is a well musculated bulbous structure covered externally by hard chitin. The anal opening is transverse.

There is only one pair of salivary gland situated one on either side of the oesophagus. They are tubular in structure and the tubules are coiled in a zigzag fashion. Anteriorly each gland gives off one pair of ducts, one of which from each gland goes straight forward, separately, to open at the base of the salivary chamber in the salivary syringe. The other duct which is blind, coils up in the same way as the gland itself and remains in close association with the salivary gland. There is no salivary receptacle, probably this blind coiled duct serves as a tubular salivary receptacle.

38. Studies on the Odoriferous Gland in Pentatomid Bugs. (Heteroptera : Hemiptera). Part I. *Tessaratoma javanica*, Thunb.

K. C. BOSE, G. P. TULSYAN and P. B. SINHA, Ranchi.

The present knowledge of the structure, development and functions of odoriferous glands in Pentatomid bugs is meagre and unfortunately it has been erroneously named by various workers due to misinterpretation of its functions.

In *Tessaratoma javanica*, a pest on 'Lichi' (*Lichi chinensis*—Fam. Sapindacae) and 'Kusum' (*Schliechera-oleosa*) trees. The odoriferous glands in the nymphal and adult stages present a good deal of disparity as regards their structure number and position. The functions, however, remain the same. Thus in all the nymphal stages right from the first there is a pair of these glands suspended from the abdominal tergum by means of their ducts and lying dorsal to the alimentary canal. Each duct opens to the exterior by means of a pair of openings situated on either side of the mid-dorsal line. There are two more pairs of rudimentary openings, respectively called as the first and the fourth pair. The present authors could not find any gland corresponding to these openings as reported by earlier workers. Each gland gives a bulbous appearance and can be easily divided into a thin walled anterior and thick walled posterior portion. The posterior part is thrown into foldings richly supplied with trachea and closely invested with Malpighian tubules.

Histological studies of the nymphal odoriferous gland suggest that the wall of the gland is always single layered. The posterior thicker and more convoluted wall consists of a single layer of long uni-nucleated secretory cells with a thin external layer of basement membrane and an equally thin layer of wavy intima. The anterior portion which is more smooth and thinner consists of comparatively smaller cells square or rectangular in shape and multinucleated. The nuclei are evenly distributed. The cell-walls are indistinguishable in some portions.

In the adult insect the paired nymphal abdominal gland atrophies and a single meta-thoracic gland develops *de novo*. The rudimentary tergal glands of the nymph are also present in their corresponding positions. The gland proper is a double walled sac like structure and lies in a cavity bounded by a chitinous framework. The gland opens into a pair of lateral ducts which in turn open on the suture between the meso and meta-thoracic sterna by a pair of openings, one on either side of the mid-ventral line.

In transverse sections the internal wall of the gland shows a single layer of cells with large round nuclei. The cells in some portions are aggregated and have lost their cellwalls. Prominent dark brown bodies are also clearly seen in the cytoplasm under high magnifications. The dark staining chromatin granules which are so characteristic of other glandular structures are completely lacking from these odoriferous glands. The layer of cell is bounded externally by a layer of basement membrane and internally by a thinner layer of very wavy intima.

The obnoxious secretion of these glands is whitish yellow in colour and oily in nature. The odour is pungent; action sightly acidic and corrosive to the skin. The gland has been termed as 'stink gland' by Muir (1907) and 'scent gland' by Drake (1960). Imms, however, terms them as 'meta-thoracic odoriferous gland'. The present authors agree with Imms' nomenclature on grounds of the position and functions of the gland. The possibility of its use in any sexual behaviour is completely ruled out firstly as it appears right from the first nymphal instar where there is no trace of the gonads, and secondly the odour of the fluid is the same in both the sexes. Hence it can not be called a homologous structure to the scent gland of Lepidopterans. The position, mechanism of functioning and the nature of fluid of these glands is entirely different from those of the stink gland of Hymenopterans and hence this nomenclature is not applicable. The arrangement of cells in villus form, presence of dark brown bodies and the absence of dark staining chromatin granules are entirely new things for glandular structures.

39. Anatomy of the Reproductive Organs in *Dysdercus konenigii* (Fabri.).

N. B. CHATTERJEE (Shyamsundar), A. K. BASU, D. N. RAYCHAUDHURI,
Calcutta.

The female reproductive system consists of a pair of ovaries extending ventrolaterally from the metathorax to the sixth abdominal segments on either side each consisting of seven acrotrophic ovarioles not in one plane, a pair of oviducts, a common oviduct, a median accessory gland, and spermatheca. Each ovariole consists of a terminal filament, germarium, vitellarium and pedicel. The two tissues of greatest interest were trophocytes of the germarium and the follicular epithelium. Histologically three zones of the germarium could be recognised. All stages of differentiation of the follicular epithelium could be found in a single ovariole. The formation of the follicular plug and corpus luteum could also be detected.

The male reproductive system is comprised of a pair of testes situated in the fifth abdominal segment on either side each consisting of seven follicles not in one plane, a pair of vasa deferentia, the proximal part of which forms the seminal vesicle while the distal part passes through a glandular structure, the mesadenes, the common vas deferens and an erection fluid chamber containing inside it an accessory gland and an ejaculatory duct. In connection with male reproductive organs interest was mainly focussed on the histology of testis. Four different zones i.e. germarium, spermatogonia, spermatocyte and spermatid could be differentiated. No apical cell could be detected.

Anatomical positions and histology of the different parts, besides those mentioned above, have also been dealt with in detail in the paper.

40. Spiracular System of *Aspongopus obscurns*

B. S. CHAUHAN, Gorakhpur.

There are 9 spiracles present in females and 8 spiracles present in males. Two of which are thoracic and rest abdominal. First thoracic spiracle is situated on the membrane between pro- and mesothorax and second thoracic spircale is present between meso- and metathorax. The abdominal spiracles differ from the thoracic spiracles in having a prominent process, the manubrium and in the absence of opercula. The thoracic spiracle open while the abdominal spiracle close by their own elasticity. Thoracic spiracles are closed with the help of dilator muscles which arise on the peritreme and its contraction brings convex opercula closer and closes the opening. Hairs are present on the opening which help in guarding the foreign materials. Abdominal spiracles have an outer chamber the atrium in which lies the stigmal opening and inner chamber the trachaeal sac from which arise tracheae. Dilator muscles are attached on manubrium which help in closing the spiracles.

41. Tracheal System of *Aspongopus obscurus.*

B. S. CHAUHAN, Gorakhpur.

There are 8 spiracles in male and 9 spiracles in female two of which are thoracic and rest abdominal. From each spiracle tracheae were given out. First and second thoracic spiracles open into the air sacs which give out tracheal branches and air sacs. First spiracles sends out following main branches. One posterior dorsal, one outer dorsal, two anterior ventral, one median mesal, and one ventral posterior. Second spiracles gives following branches. One anterior dorsal, one outer dorsal, one transverse mesal, two anterior ventral, one ventral posterior. Each abdominal spiracles sends out three main branches, dorsal, mesal and ventral. Dorsal branch divides into two, the anterior one unites with posterior one of the preceding segment while the posterior branch meets the anterior one of the following segments which results in formation of dorsal longitudinal trunk on either side and numerous air sacs are given out from the tracheal branches.

42. Siphunculus and associated structure of Aphis nerii Boyer.

B. CHOWDHURY and D. N. ROY CHOUDHURY, Calcutta.

Aphis perii Boyer colonizes Calotropis species. Both alatae and apterae are provided with a pair of chitinous processes from the dorso lateral aspect of the 5th abdominal segment known as 'siphunuclus'. Through the siphunculi comes out a secretion "honey dew".

In sections a siphunculus is noticed to be made up a heavy chitinous layer outside and a muscle layer inside. The muscles of the two sides form the boundaries of a canal inside. The chitinous and the muscle layers of both sides are pushed inwards to form a valve like structure at the origin of the siphunculus from the body. Near this structure and within the body of the insect are observed large vacuolated mononuclear cells. These cells are perhaps responsible for the secretion of the honey dew and the valve of the siphunculus is perhaps for regulating the flow of the secretion.

The chemical nature of the secretion is under investigation but the presence of a volatile substance can not be doubted because of the quick hardening of the secreted material in contact with atmospheric air.

43. A note on the relative efficiency of various Parasites of Jute stem Girdler under the natural conditions.

N. DUTT, Barrackpore.

Neocatolaccus nupserhae Dutt & Ferr.; *Norbanus acuminatus* Dutt & Ferr.; *Ipobracon* sp., *Spathius* sp., *Goryphus* sp. have been recorded as the larval and pupal parasites of jute stem girdler, *Nupserha bicolor postbrunnea* Dutt. Of these, *N. nupserhae* and *N. acuminatus* are the most efficient parasites and these two together account for maximum parasitisation during the jute season in 1953-54. Parasitisation occurs between the months of July and October, the peak period being in the month of August when nearly 22 per cent parasitisation was done by them. A survey of parasitisation carried out during this peak period, namely the month of August, 1961, indicated that *N. nupserhae* accounted for 11·90 per cent, *N. acuminatus* for 9·11 per cent and others for 2·02 per cent parasitisation.

N. nupserhae and *N. acuminatus,* thus, appear to be of greater economic importance than others. Males are unknown in *N. acuminatus* and the ratio between the females of *N. nupserhae* and *N. acuminatus* has been found to be 1 :0·4. Sex ratio between females and males of *N. nupserhae* has been recorded to be 1 :0·38.

44. Observations on the mouth-parts of Cybister Tripunctatus Asiaticus Sharp (Dytiscidae, Coleoptera).

S. C. GOEL, Saharanpur.

Snodgras (1932, '50), Imms (1939) and Dorsey (1943) described the organs of feeding in Coleoptera. The description and structure of the mouth-parts in Dytiscidae are found in the works of Sharp (1882), Bordas (1901) and Korschelt (1924). The head-capsule in Cybister includes paired antennae, mandibles, maxillae and a single labium. The last three are collectively known as mouth-parts. *Antenna* :—is a filiform, eleven jointed structure, tapering base to apex, with sensory pubescence pits in each segment, situated in front of the head lying lateral below the eyes. The scape is large and broad while the pedicle is shorter and followed by the nine joined flagellum without any setae. *Labrum* :— is a single, broad, flat sclerite, deeply notched at the anterior margin, with numerous sensory bristles arising from the sensory pits at the anteroventral margin. Posteriorly it bears two chitinous structures. *Mandible* :—adapted for biting and chewing the flesh, is more or less triangular, convex laterally while inner margin bears many stout teeth along with sensory bristles. Each mandible is a solid compact piece articulating in the concavity of the head known as ginglymus. *Maxilla* :—is with distinct sclerites as cardo, stipes, palpifer, galea, lacinia and maxillary palp. The cardo is a proximal piece articulating with cranium by means of basal condyle; stipes in a triangular piece articulating with cardo and palpifer bearing galea and lacinia on the outer hand. The palpifer have four segmented maxillary palp. The lacinia is lobelike armed with numerous sensory bristles at the distal border and well chitinized teeth at the tip. Galea is simple, tubular, two segmented and without any teeth or spine. *Labium* :—is a single, bilateral structure with two sclerite at the proximal end, gulamentum followed by mentum. Anterior to the mentum is the prementum in the form of small sclerite and bears a pair of palpiger. The ligula is formed by the fusion of glossa and paraglossa and anteriorly armed with sensory bristles, lodged in their pits dorsally. Ventral to the ligula is a pair of three segmented labial palp. The mouth-parts are prognathous and well adapted for the carnivorous habits of the beetle.

45. Observations on the head-capsule of Cybister Tripunctatus Asiaticus Sharp (Dytiscidae, Coleoptera).

S. C. GOEL, Saharanpur.

Stickney (1923), Snodgrass (1932, '35, '47), Ferris (1942) and Imms (1957) described the insect cranium and cranial sutures in a number of beetles. The paper includes the description of the head-capsule of Cybister tripunctatus, which is a chitinized, more or less oval structure. The dorsal surface of the head is known as epicranium which is a single sclerite extending from the foramen magnum to clypeo-frontal suture and laterally hanging over the eyes. The Y-shaped epicranial suture, variable in different insects (Snodgrass 1947), is not well developed and divides epicranium into two lateral epicranial plates. The frons extends laterally upto the eyes and is unpaired upper facial part of the head. The clypeus, anterior to the frons is separated by means of clypeo-frontal suture from each other. The labium is a well pronounced, movable sclerite articulated with the clypeus by means of clypeo-labral suture. The paired, large and bulging eyes are situated at the dorsolateral wall of the cranium without any ocelli in between the eyes. The head is ventrally supported by means of gula, extending from the post-occipital rim of the foramen magnum to the labium anteriorly. The two lateral sides are genae. The genae at their sides bear paired maxillae, antennae and mandibles. The gula and submentum are fused into a single plate termed as gulamentum. The head-capsule of Cybister has developed the fusion of sclerites.

46. Structrue of the Ovipositor in *Anisops bouvieri* Kirk. (Heteroptera : Notonectidae).

A. K. GORAI, Midnapore.

Anisops bouvieri is found abundantly in the fresh waters of Midnapore district of West Bengal. In female the abdomen is ten segmented, the first one is reduced, the ninth forms the genital armature and the tenth the anal siphon.

The ovipositor consists of two pairs of valvifers and three pairs of valvulae. The first pair of valvifers are triangular plates attached to the sides of the eighth tergum. The second pair is placed inner to the first and forms a sort of an arch dorsally. The ninth tergum is modified to form the second valvifer.

The first pair of valvulae are elongated plates serrated along their inner margins. These are attached to the second pair of valvifers by ligament. The second and third pairs of valvulae are short processes arising from the second pair of valvifers.

The eggs are deposited into the holes on the stem and leaf peduncle of Myrmeophyllum heterophylla, dug by the ovipositor. The first pair of valvulae together rub against the stem or leaf-peduncle and thus a hole is produced in the plant. The mature eggs are slipped through these holes and deposited inside for further development.

Several muscles are associated with the ovipositor for the movement of different parts.

Details will be published elsewhere.

47. Study on Gall Midge (Itonididae : Cecidomydae-Diptera-Nematocera) from India.

P. GROVER, Allahabad.

Subfamily *HETEROPEZINAE*

Meinertomyia ovalis, sp. nov.

A new species of the genus *Meinertomyia* Felt has been described in the present paper. The diagnostic features of the species are.—eyes confluent above; palpi triarticulate; antenna with 14 segments, shorter than the length of body, third and fourth antennal segments not fused and unequal; vein *Cu* simple and faint; legs long, with five tarsal segments, metatarsus shorter than the second tarsal segment; claw simple and strongly bent; empodium longer than the claw; ovipositor with one dorsal broadly oval and two elongated oval ventral lamellae.

It differs from the known species by the above mentioned characters.

Meinertomyia Felt is one of the very old genera having been erected in the year 1911 with *M. faciata* Felt as the type. Mani in 1934 recorded this genus for the first time from old world and described *M. aequipalpis. M. inaequipalpis* a second species was described by the same author three years later. Third species *M. manii* was described by Rao in 1949. The present species is the fourth to be described from the oriental region.

48. Taxonomy, Zoogeography and Evolution of the Indo-Australian species of the Genus Theronia (Hymenoptera).

V. K. GUPTA, Michigan.

49. The Blood Vascular System of *Labidura riparia*, Pallas, Var. *inermis*, Brunner.

KUSUMAVATI KADAM, Jabalpur.

The blood vascular system of *Labidura riparia,* Pall., Var. *inermis,* has been studied in detail. It does not consist of closed distributing and collecting vessels. The blood flows freely through definite chambers formed by means of diaphragm. There are in all three longitudinal chambers; dorsal or pericardial, perineural and median or perivisceral. The main blood propelling organ is the dorsal vessel. The blood has no haemoglobin and hence do not supply oxygen to the tissues.

The dorsal vessel is a long tube extending anteriorly from the ninth abdominal segment into the head. Posteriorly it is chambered and forms the heart proper. Anterior tube is the aorta. The systolic and diastolic movements are clearly seen in a freshly dissected specimen. Each chamber is dilated posteriorly and is perforated by a pair of ostia, guarded by muscular valves.

The dorsal diaphragm lies immediately below the heart and at some places margins of the diaphragm are drawn out into points. The free margin between these attachments form deep semi-circular notches through which the pericardial sinus communicates with the perivisceral sinus. The ventral diaphragm is a long muscular sheet lying above the ventral nerve cord. The free ends of the diaphragm allow communication between the perineural and perivisceral sinuses.

Blood is a colourless fluid and consists of the plasma in which float the blood corpuscles. Blood corpuscles are of four types; 1. Macronucleocytes with large nuclei, 2. micronucleocytes with small nuclei, 3. large vacuolated fat cells and 4. amoeboid cells.

The course of circulation of blood is described in detail.

50. The Secretory System of *Labidura riparia* Pallas, Var. *inermis*, Brunner.

KUSUMAVATI KADAM, Jabalpur.

The main organs of excretion are the malpighian tubules. The integument, tracheae and nephrocytes also help to some extent in the process of excretion.

The malpighian tubules are long, thread like structures attached in four groups to the posterior end of the midgut, each group consisting of 10 to 12 tubules. The base of each group is dilated to form a basal vesicle at the point of attachment with the gut. The tubules are yellowish in colour due to the presence of waste matter in them. They lie free in the body cavity and are kept in position by a network of tracheae. Slow movement of the excretory matter in the tubules is noticed in a freshly dissected specimen in normal saline, which is brought about by two or three fine longitudinal muscle fibres present in each tubule.

Histology of malpighian tubules is also studied.

51. Digestion and Absorption of Food in *Tribolium castaneum* (Herbst.).

S. S. KRISHNA and K. N. SAXENA, Delhi.

Investigations on the digestive enzymes in the gut of larva and adult *Tribolium castaneum* (Herbst.) show that the insect possesses an amylase, a maltase, an invertase, an α-galactosidase, a β-galactosidase, a β-glucosidase, a proteinase and an esterase. The invertase of this insect is an α-*d*-glucosidase. The enzymes polypeptidase and lipase are totally wanting. All these enzymes, which differ from one another in the range of pH within which they show activity, bring about maximum hydrolysis at pH 5·5. Concentration of the enzyme invertase in the mid-gut of the insect remains more or less the same regardless of the time of its feeding and that in the hind-gut increases with the time-lapse after the meal. Different carbohydrases differ from one another in their relative concentration in the gut and they may be arranged in the following order according to their relative strength : amylase > invertase > β-glucosidase > α-galactosidase > β-galactosidase. Studies on the hydrogen-ion concentration of the gut of *T. castaneum* indicate that the pH in all the regions of the gut in both the larva and the adult is $> 5{\cdot}2 < 6{\cdot}0$ except for a short zone in the hind part of the mid-gut of the larva where the pH is $> 6{\cdot}8 < 7{\cdot}0$. Change in pH of the diet does not affect the pH of the gut. Observations on fate of invested food within the gut reveal that digestion of sucrose and absorption of glucose and fructose occur in the mid-gut of the insect at a fairly rapid rate so that they are completely utilised before the food-residue is passed out. Correlation between the natural source of food of the insect and its capacity to digest, absorb and utilise the available nutrients is discussed.

52. Feeding response of adult *Tribolium* to Carbohydrates in relation to their utilisation.

S. S. KRISHNA and K. N. SAXENA, Delhi.

Study of the role of certain carbohydrates in stimulating ingestion of food by adult *Tribolium castaneum* indicates that the feeding activity of the insect is greater on sucrose and fructose than on starch, maltose, glucose, raffinose, melibiose and agar agar. However, wheat flour, the natural food of the insect, elicits a significantly greater feeding response than any of these carbohydrates. Investigations on the capacity of *T. castaneum* to digest and absorb these carbohydrates show that the insect is physiologically adapted to utilise them. As regards nutritional efficiency of these carbohydrates for survival of adlult insect, starch and maltose support maximum length of life. Glucose, melibiose and lactose are comparatively less efficient in supporting adult life while the nutritional efficiency of the remaining carbohydrates namely, fructose, sucrose, melezitose, raffinose and cellobiose is very poor. Correlation among the relative proportion of different carbohydrates in the cereals, capacity of the insect to digest and absorb them and their efficiency to support its survival is discussed.

53. Post-embryonic Development of Skeleto-muscular system of thorax in *Dysdercus kœnigii* (Fabr.) (Heteroptera).

SUDARSHAN KUMARI, Delhi.

Study of changes in skeletomuscular system of thorax of *Dysdercus koenigii* during its post-embryonic development reveals that the sclerites of this region not only increase in size but also undergo a progressive differentiation. In the first instar nymph the pronotum is a single plate which, in the second instar, gets differentiated into three subequal sclerites. In the fifth nymphal instar the third pronotal sclerite becomes much larger than the second and approximates the condition found in the adult. The meso- and metanota of the first instar nymph also consist of a single piece each almost equal in size. In the third instar the mesonotum becomes twice as long as metanotum. The transscutal and scuto-scutellar sulci are formed only after the final moult to the adult.

Rudiments of the fore- and hindwings appear in the third nymphal instar. In the fourth instar nymph two main tracheae enter the wing pads, each divides into three and all the six tracheae later form the longitudinal veins of the adult. Development of the articular sclerites of the wings occurs during the final ecdysis of the fifth instar nymph.

Thoracic musculature of the nymph differ from that of the adult in the smaller size, lesser number and arrangement of various muscles. However, certain muscles *viz.* the second dorso-ventral muscle of the mesothorax and the ventral oblique muscles of the meso- and meta-thorax are present only in the nymphal stage and not in the adult. A number of muscles, particularly those of the wings present in the adult insect, are wanting in the early nymphal stages. Their development is closely related with that of the wings.

54. Studies on the Grasshopers of Pilani (Rajasthan).

H. L. KUNDU, A. K. DATTA GUPTA and L. M. L. MATHUR, Pilani.

Certain aspects of the external morphology, abundance in the field and habitat of *Acrotylus humbertinus* Sauss. and *Spathosternum prasiniferum* Walk. (Acrididae) have been studied. Weights of the body as well as the legs were taken and the lengths of the different parts of the body such as elytra etc. have been measured. Fifteen specimens of each sex and sixteen linear measurements on each individual's body parts were taken. Attempts were made to examine the data by computing the variance and standard error (S.E.). The ratios between the weights of the hind legs and the body were obtained.

These data were studied with a view to examining variations at both intra and inter specific levels and in certain cases significant differences amongst them noticed. A tentative explanation has been put forward to explain such differences.

Tibial spines were counted and their distribution recorded. Abundance of these grasshoppers in four different plots during the monsoon and winter of 1960 was estimated. Certain conditions of the habitats of these grasshoppers such as, soil moisture, weather and vegetation were also studied.

55. Control of the lissora fruit weevil, *Baris codiræ* Marshall (Insecta : Curculionidae), a serious pest of Rajasthan.

K. S. KUSHWAHA, J. C. SHARMA and L. S. SHARMA, Udaipur.

Kushwaha has already studied the biology, external morphology, damage and the measures of preliminary control of the lissora weevil, *Baris cordiae* Marshall (Subfamily Baririnae) infecting about 88 per cent fruits of lissora of goonda (*Cordia dichotoma* Frost. f., syn. *Cordia myxa* Roxb. and *Cordia oblique* Willd.) around Udaipur as observed since 1957. The infestation starts mostly during March and April.

Further trials to control this borer were conducted during 1960 and 1961 in different localities at Udaipur. The following insecticides were used as bloom sprays in concentrations mentioned against each : Endrin 20% EC. (0·025%, 0·05% and 0·1%), DDT 50% WP. (0·25%), BHC 50% WP. (0·25%), Folidol 46·7% EC.

(0·025%) and Ryania 90% WP. (1%). Of these, only Endrin has statistically given highly significant results over control and other treatments in all the three concentrations (*vide supra*), whereas in other cases the results were insignificant. Further it was noted that the three doses of Endrin were insignificant amongst themselves.

56. Relative role of Abrasive Dusts, Activated Clays and Gas Absorbing Carbon on *Tribolium castaneum* adults.

S. K. MAJUMDER and M. K. KRISHNAKUMARI, Mysore.

Acid activated clays were found to be more insecticidal than the abrasive dusts, such as carborundum, emery and glass powders. Silica gel and carbon were hygroscopic and lost insecticidal potency, while active clay, being less hygroscopic, maintained its insecticidal potency when stored in non-airtight containers. The insecticidal actions of the dusts were primarily related to the lipophilic activity and removal of lipoids from the insect cuticle. Relative humidity of the microclimate exerted secondary action on the insect mortality. The rapidity with regard to death of the test insects depend on the relative humidity of the atmosphere and also of the micro-climate during the tests. Desiccant like $CaCl_2$, had very little insecticidal effect. Even at 53% relative humidity, the abrasive dust failed to induce mortality of test insects within 96 hours of exposure, while active clays and freshly prepared carbon were highly effective and induced mortality within 16 hours. The results of the present study indicated that, sorptive dusts kill insects by removing lipoid from the insect cuticle and not by direct desiccant action, and subjecting them to the loss of moisture. The rapidity of which depended on the degree of unsaturation with regard to the moisture in the atmosphere and not the sorptive properties of the materials.

57. The Occurrence of Spinose Ear Tick, *Otobius megnini* Duges, 1883, in Poona, Maharashtra State.

P. BALARAMA MENON, Cuttack.

This paper records the presence of the Spinose Ear Tick, *Otobius megnini* Duges (Syn : *Ornithodorus megnini*) in horses in Poona and nearby localities. This is the first record of this uncommon species of tick from this part of the country and is a new locality record for the species in India. Large numbers of the nymphal stages of the tick and a few in the larval stage were collected from inside the ears of horses both country bred as well as from a well maintained stud farm. It was believed that the Indian bred horses contract the infection from imported ones from endemic countries. But the present finding reveals the infestation as more widespread and occurring in indigenous breeds which could have had no contact with imported horses.

58. Dimetilan as a poison bait for the control of houseflies.

P. BALARAMA MENON, Cuttack.

A red coloured cartoon disc impregnated with a chemical belonging to the carbamate group, Dimetilan, as well as an attractant, produced by Geigy, Switzerland, was tested for the control of houseflies, *Musca domestica nebulo* (Fabr.). A series of experiments conducted on fed as well as starved houseflies showed that flies are attracted to the discs on which they feed without hesitation and die immediately after. Normal fed flies as well as those starved over night feed readily on the disc. More than 90 per cent kill was obtained. Even in the presence of milk, a large percentage of flies were attracted to the disc.

Dimetilan acts chiefly as a stomach poison and since its solubility in water is of decisive importance, the disc is to be kept moist to obtain its full effect. The disc contains, within a small surface, a relatively high concentration of active ingredient in the form of water soluble stomach poison. The toxic hazard involved in the use of this product is claimed to be practically nil.

59. Studies on the morphology of the various developmental stages in the life-history of the tea mosquito bug, *Helopeltis theivora* Waterhouse.

D. MUKERJI and RAMKRISHNA GHOSH, Calcutta.

Since the discovery of *Helopeltis theivora* from the Indian tea gardens by Waterhouse in 1886, no further description of the species has ever been attempted. The present observation chiefly deals with the description of the nymphal stages of the insect. There are five nymphal stages before the imagos are obtained from the egg. The main changes at different stadia are as follows :

1. The scutellar horn which is the characteristic of the species appears as a protruberance in the first nymphal stage, it becomes fully formed in the fifth instar.
2. Wing pads appear at the fourth instar stage.
3. The external genitalia appears at the fourth instar stage and becomes fully formed at the final instar, when the distinction between male and female insect becomes possible.
4. Wing venation of the adult insect has been described and the measurement of the various parts of the body has been taken of the different stages in the life-history of *Helopeltis.*

60. Notes on the Biology of *Epilachna vigintoctopunctata* M.

G. P. MUKERJI, Bhopal.

Epilachna vigintoctopunctata M. is fairly well distributed and quite common in different parts of India. In the breeding season it appears in good number and causes severe damage to different cucurbetaceous and solenaceous vegetables. In this paper the author has attempted to give some information regarding the life-history of the beetle.

The insect starts copulating about a week after their emergence from the pupa. Soon after copulation they start laying the eggs. The eggs are laid in batches and attached firmly to the leaves or muslin. They are delicate, light yellow, barrel-shaped having a narrow anterior end. On the 11th day eclosion takes place and the first stage larva is given out. There are four larval instars each of five to seven days duration. These grub-like, slow moving, small-sized larvae feed voraciously. The different instars are distinguished by the size and the branches of the bristles on the dorsal side which increase in every successive moult. For pupation the final instar larva attaches itself to the leaf or muslin with the dialated anus; Post. adhesive disc Mukerji (1959) and prepares for pupation. The pupa is a non-feeding obtect pupa. Antennae and the legs are soldered down to the body. In some of the pupae the final instar exuvia remains attached while in others it is only clothed in a thin, hairy pupal covering. The adult emerges from the pupa after about seven days. After few hours of emergence the adults show the normal movements, take to flight and start feeding actively. Both the sexes look alike except that the males are smaller in size.

61. The effects of temperature and humidity on the development of different stages of *Callosobruchus maculatus* Fabr.

M. K. MUKERJI and D. N. RAY CHAUDHURI, Calcutta.

The effects of temperature (20°C—35°C) and relative humidity (45%—90%) on the developmental stages of *Callosobruchus maculatus* Fabr. were noticed. It was found that the relative humidity of different percentage at all temperatures (20°C—35°C) have no effect on the egg, larval and pupal periods. The increase of temperature (20°C—25°C—30°C—35°C) decreases in the number of days for development of the various stages.

The temperature of 20°C seems to be the optimum for the proper development of this insect as the total number of days required for total development is maximum at the temperature and which phenomenon is essential for maintenance of a race.

62. Some Parasites associated with Coccids and their possible utilisation in the biological control of Coccids.

E. S. NARAYANAN and B. R. SUBBA RAO, New Delhi.

There are very few insect pests that are immune to the attack of parasites and predators. This phenomenon is particularly emphasised in the case of coccids that are attacked by encyrtids, miscogasterids and eulophids. While eulophids and miscogasterids are casually reared from coccids, encyrtids as a rule dominate as primary parasites of coccids.

In this paper three coccids namely, *Phenacoccus* sp., *Lecanium* sp. and *Ceroplastes* sp. were reared in the laboratory from the field collected material for possible emergence of parasites. The miscogasterid *Anysis alcocki* (Ashmead) was reared from both *Ceroplastes* sp. and *Lecanium* sp. while *Ceroplastes* is a known host, *Lecanium* has been recorded as a new host in India. A species new to science *Cerapterocerus indicus* has been reared from *Lecanium* and described. Another species *Aphycus zebratulus* new to science is also described. Field observations showed that there was no multiparasitism by these two species. Natural parasitism was about forty per cent.

Aphycus zebratulus new species, comes very close to *Aphycus zebratus* Mercet but differs from it considerably. So also *Cerapterocerus inducus* new species differs very much from the two known Indian species *C. virens* Alam and Man Mohan and *C. antennatus* Narayanan. *Cheiloneurus* sp. runs very close to the described *C. pyrillae* Mani but differs from it in certain characters. Further studies are in progress.

From the brinjal mealy bug *Phenacoccus* sp., thee species of parasites were reared, namely, *Leptomastix* sp., *Cheiloneurus* sp. and *Pholidoceras* sp. It is possible that *Leptomastrix* sp. and *Cheiloneurus* sp. are new to science.

The coccids and mealy bugs have always posed as a serious problem to economic entomologists. On account of their staggering rate of reproduction and the uneconomic proposition of the chemical method of control over large areas, the biological method of control has been a success in the case of some of these pests. The discovery of these new parasitic species will give an impetus to workers on biological control to utilise them for field trials for the control of these pests.

63. Respiratory metabolism during embryogenesis of a diapause species of field cricket, *Gryllus pennsylvanicus* Burmeister (Orthoptera : Gryllidae).

R. RAKSHPAL, Lucknow.

During the embryonic development of *Gryllus pennsylvanicus* the rate of respiration continues rising until the fifth day, after which the rate falls off to about one-ninth on the tenth day. This value is maintained for a further period of ten days. In the post-diapause embryos the rate of oxygen consumption rises continuously throughout the entire period of development. The studies reveal that the diapause in *G. pennsylvanicus* is obligatory and that the embryos enter physiological diapause one day later than the morphological diapause and enter a complete diapause condition after a further period of five days. The post-diapause embryos take three days to reach the maximum rate of respiration of the pre-diapause period.

64. The Neurosecetory Cells in the Beetle, Heliocopris bucephalus F.

P. V. RANGNEKER and H. B. NIRMAL, Amravati.

The distribution of neurosecretory cells in the central nervous system of *Heliocopris bucephalus* F. resembles on the whole to that of fruit fly, *Chaetodacus cucurbitae* Coq. (Nayar, 1954). But in *Heliocopris bucephalus* on the basis of the structure and staining properties, it has been possible to identify three types of neurosecretory cells; and they have been designated as A, B, and C types. All the three types of cells are reprsented in the thoracic and abdominal ganglia. However in the brain, B-type is absent while the other two types are present.

The A-type of cell shows numerous small vacuoles and their number on the average is twenty in each cell. The B-type of cell possesses a single large vacuole extending over a major area of the cell. Presence of vacuoles indicates a high degree of activity on the part of neurosecretory cells; wherein there is a constant elaboration followed by quick withdrawal of neurosecretory material. In the A-type of cell the numerous small vacuoles appear to converge on the origin of axon; while in the B-type the single large vacuole extends into the axon. These observations suggest that the neurosecretory colloids formed inside the cell are transported through axon. These observations on the axonic transport of the secretory material, support the earlier findings by Scharrer (1952b) in Leucophea; Arvy, Bounhiol and Gabe (1953) in Bombax; Arvy and Gabe (1954) in Plecoptera; E. Thomson (1954) in Calliphora and M. Thomson (1954) in Hymenoptera. The C-type of cell shows complete absence of vacuoles but at the same time neurosecretory material is observed flowing into the axon of this cell. On the basis of the number, size and disposition of vacuoles present in the cell it can be surmised that the degree of activity in the B-cells is higher than that of the A-cells. Since the C-type of cells do not show any vacuoles it is suggested that its degree of activity is the lowest.

65. The anatomy of the Digestive organs of *Sphærodema rusticum* Fabr. (Heteroptera : Belostomatidae).

S. C. RASTOGI, Pilani.

Sphaerodema rusticum is a fresh water and predacious hemipteran. It feeds upon aquatic insects such as dragon-fly larvae, crustaceans, mosquito-larvae and larvae of aquatic bettles. In captivity it does not attack any organism.

The alimentary canal is divisible into three primary divisinos, viz., the foregut, midgut and the hindgut. There is no true mouth and the sucking beak is three segmented. The foregut consists of a sucking pump (pharyngeal pump) and an oesophagus. The pump is a V-shaped sclerotised trough whose roof is invaginated into the chamber to form an operculum. The operculum is provided with dilator muscles which originate from the clypeal area. The oesophagus is tubular and lined by cuboid cells. A thin layer of chitin is secreted by the cells. The oesophagus extends back into the midgut and forms the oesophageal valve.

The midgut is differentiated into four regions. Midgut is characterised by the presence of columnar cells and absence of an intima and peritrophic membrane. Another feature of the midgut is the presence of regenerative cells enclosed in dome-shaped pockets called 'nidi'. They give rise to new epithelial cells by a process of proliferation. The epithelial cells show periodic delamination and the secretions enter the lumen by holocrine method only.

The hindgut is composed of an ileum and a rectum. A thin-walled rectal caecum arises from the rectum at the junction of the ileum and the rectum. Ileum is composed of two types of epithelia. The normal epithelium is unfolded and consists of tall cells without cell boundaries. The cytoplasm is vacuolated and perforated by tracheal openings. The other epithelium of the ileum resembles the epithelium of the rectum and the rectal caecum in all details. The caecum is a respiratory and hydrostatic organ. A well developed proctodaeal valve is present.

There are four Malpighian tubules which arise from the midgut slightly anterior to the proctodaeal valve. The salivary glands consist of a pair of principal and a pair of accessory glands. The principal glands are aciniform while the accessory glands are vesicular.

66. Observations on the life-history of Red Pumpkin Bug, *Coridius janus* Fabr. (Heteroptera : Dinidoridae).

S. C. RASTOGI and MISS KRISHNA KUMARI, Pilani.

Coridius janus Fabr. is pest on cucurbitaceous plants such as *Cucumis sativus*, *Luffa cylindrica*, *Luffa acutangula* and *Lagenaria vulgaris*. Nymphs and the adults actively feed upon the plants. Breeding in the bug commences during the rainy season i.e. from July to September and during this time they form heavy infestations on the cucurbitaceous plants. The males are smaller with brilliant orange red colour while the females are larger with dull red colour. Late evening and dark hours of the night favour copulation which lasts for 2 to 2½ hours. Eggs are laid in chains and each measures about 1·8 mm long. When freshly laid, the eggs are bluish white but later on the colour changes to reddish brown and subsequently to dark brown at the time of hatching.

The life-history of *Coridius janus* consists of five nymphal stages and is completed in 25 to 30 days. The phenomenon of moulting of each nymph is as usual, as in other bugs. First of all the skin becomes loose and gradually braeks near about the mid-dorsal region of the thorax. The head comes out first, followed by the remainder of the body. The newly moulted instar is pinkish which gradually attains its normal red colour. The process of moulting does not last more than 15 minutes. The measurements of the different parts of the body in each nymphal stage have been given in the paper. The length of the antennae shows a considerable growth in relation to each nymphal stage. Growth ratio has been shown graphically.

67. Biology of *Chrysccoris stollii* Wolff Pentatomidae (Hemiptera-Heteroptera).

A. ROY and D. N. ROY CHOUDHURY, Calcutta.

Chrysocoris stollii Wolff is a pest chiefly on various *croton* species in and around Calcutta. The insects are found almost throughout the year. But the number greatly increases after the rainy season and in autumn and the same decreases very much during summer. The number of females is always more than the number of males. The insects are found in copula more during winter than during the rest of the year. In general the insects are less frequent during mid-day when they hide themselves in suitable humid places.

The insects feed on the plant sap either from the fruit or from the leaves or stems.

Before copulation the insects perform a sort of a courtship for about 15 to 30 minutes. Copulation starts in the afternoon and the period lasts for about 17 to 20 hours. Pre-ovipsoition period is 3 days. The pearly white eggs are laid in batches of 7 to 31 in double row.

68. Food intake in relation to the growth of *Dysdercus kœnigii* Fabr.

K. N. SAXENA, Delhi.

Observations on the fluctuation in the feeding activity of fifth instar nymph of *Dysdercus koenigii* at different stages of its growth and on the effect of food intake on the growth of the insect are presented in this paper. Feeding activity of the insect is best expressed in terms of duration of feeding per 4-hour period per individual and also on the basis of percentage of individuals showing feeding response. During the fifth nymphal instar the insect starts feeding 16 hours after the previous ecdysis and its feeding activity reaches the maxium level between 24-32 hours after the moult. Subsequently it declines till after 80 hours the insect does not feed on the cotton seed until after the next ecdysis. Its feeding activity on the cotton leaf or on water remains uniformly low and identical throughout the instar and it is significantly lesser than the feeding activity on cotton seed during the active period between 16th and 80th postmolt hours. The individuals deprived of cotton seed only during the fifth nymphal instar continue to show high feeding activity on the seed almost till their death. They fail to moult again and survive for a period twice the normal duration of the fifth nymphal instar. On the other hand, the individuals allowed to feed on cotton seed for a restricted period during each of the five nyhphal instars show high mortality of the growing nymphs. Nevertheless, the survivors complete their development to the adult stage in the same period as the nymph given continuous access to the diet.

69. A contribution to our knowledge of Noctuidae affecting cotton in Rajasthan.

B. K. SRIVASTAVA and S. P. BHATANAGAR, Jobner.

The present authors have undertaken a systematic survey of Noctuidae affecting cotton crop in Rajasthan. The paper deals with seasonal incidence, nature of damage, life-history and distribution of Noctuidae as pest of cotton in the state. These identified noctuid pests include leafworm, *Prodenia litura* F. and lesser leafworm, *Laphygma exigua* Hb. and semiloopers, *Cosmophila indica* Gn. and *Tarache nitidula* F. on leaves; and spotted bollworms, *Earias fabia* stoll. and *E. insulana* Boisd., and gram caterpillar, *Heliothis obsoleta* Hb. on growing shoots, floral buds, squares, flowers and green bolls.

70. The flexor and extensor mechanism of the wings of *Odontotermes obesus* (Rambus) (Isoptera, Termitidae).

H. S. VISHNOI, Delhi.

The paper deals with the description of the basal articular structures of the two pairs of wings of *Odontotermes obesus* (Rambur) and their movements during flexion and extension. During repose the wings are held flat along the dorsal surface of the abdomen. The extension is caused mainly due to the coxo-subalar muscle which depresses the subalar sclerite; incidentally, the chain of the Three axillary sclerites is opened pushing laterally the anal and the median sclerites of the wing-base and hence the extension of the wings. Flexion is caused due to pleuro-alar muscle which rotates the third axillary sclerite dorso-medially on its basal pivotal articulation on the extremity of the posterior notal wing process and the third axillary thus pulls the anal sclerite of the wing base medially. During this displacement of the third axillary the second and the first axillary sclerites are also automatically rotated dorsally because of their slightly overlapping condition. On account of the hinged articulation of the first axillary with the lateral margin of the tergal plate the entire set of axillaries when rotated during the wing-flexion develops certain force of elasticity that would also contribute to reverting the wing to its extended condition when the flexor muscle is relaxed.

EXPTL. ZOOLOGY

71. Failure of organisation due to misdivision of cells in urethane treated chick embryos.

S. ADHIKARI, Calcutta.

Versatility of urethane as an extraordinary chemical which produces diverse categories of actions on the different components of a cell is rather well known. This chemical has been experimented upon developing chick embryos to intervene into organisational changes through cellular misdivision. 0·5% urethane constitutes the effective dose which has been administered into fertilised and unincubated egg-white leghorns. The end results have been scrutinised after 48 hours of incubation. The organisational set up of the treated embryos depicts a marked retardation in development. The neural tube becomes bifurcated at the anterior region, the mesodermal and endodermal derivatives fail to establish themselves. The notochord is shortened and is associated with the main axis only to some length. There is no eye cup formation and the cardiac structures are lacking altogether. Examination of ill formed tissues reveals a number of interesting changes in cell structures. The nuclei are much enlarged; cytoplasm appears granular. Often dividing cells are seen in a state of misdivision. Daughter cells cannot separate but are pulled out in opposite poles to an enormous distance. Presence of more than one nuclei is seen in large number of cells. Often mass of necrotic cells with pycnotic nuclei are observed.

72. Induction of gastric ulcers in the toad, *Bufo melanostictus* by modified Shay operation.

M. APPASWAMY RAO, Mysore.

The mechanism in the induction and formation of gastric ulcers in man is not well understood. To study the pathogenesis of their production and to find means of preventing their appearance, it becomes desirable to produce these ulcers in experimental animals. As frogs and toads are used for experimentation, the Shay operation with some modifications has been employed to induce gastric (Pyloric) ulcers in the toad, *Bufomelanostictus*.

Toads weighing 20-45 gms, kept in humidity chamber, are starved for two days. Ligation of the stomach in the pyloric (single) or esophageal-pyloric (double) region is made under ether-anaesthesia in sterile conditions. Five days after ligation, the toads are sacrificed. The incidence of animals showing ulcers is noted, severity is estimated and the number of ulcers per toad is counted. These three values are combined and expressed in terms of ulcer index.

In the pylorus and esophageal-pylorus ligated toads, the incidence of gastric ulcers is very high when compared to those of sham operated controls. With single ligation of the stomach, the ulcer index is 14·8 ± 1·1, with double ligation, it is 13·99 ± 0·96, but in the control it is only 3·2 ± 0·39. Usually 3 to 6 ulcers are found in the pyloric (Glandular) region and very few in the cardiac portion of the stomach. Histological studies of these ulcerated stomach indicate thining of the gastric mucosa with infiltration of leucocytes. In the regions of acute ulceration the gastric epithelium and sub-mucosa disappear completely. The necrosis of the gastric mucosa and sub-mucosa is due to the inflammatory reaction of the gastric juice accumulated in the stomach after ligation. It is suggested that this technique may be employed to test the anti-ulcerogenic compounds.

73. Rate of cell contact in centrifuged amoeboid cells.

S. BANERJEE and S. MOOKERJEE, Calcutta.

The rate of reconstitution in dissociated sponge cells can experimentally be altered by subjecting them to various cyto-physiological conditions. Here is one such instance of an effect of centrifugation upon the tempo of aggregation in dissociated sponge cells. The sponge cells were dissociated by the classical technique of Wilson, by seiving them through silken mesh and then subjecting them to a force of 2000 'g' and 3000 'g' for 5, 10, and 15 minutes. The rate of reaggregation in different experiments were calculated and graphically plotted.

The highest rate of contact in dissociated cells, previously centrifuged at 2000 'g' for 5 minutes, is about ·8% higher than that of the normal. Except in this series, in all other experiments, the rate of reconstitution is lower than that of the normal. The behaviour of individual cells after centrifugation during the process of reconstitution has been discussed.

74. Effects of certain drugs on the gas contents of the swimbladder.

PADMAKAR V. DEHADRAI, Delhi.

Fange (1953) in his pharmacological studies reported the effects of various sympathicolytic and symphathicomimetic drugs on the gas secreting mechanism of *Ctenolabrus rupestris* and *Gadus collarias*. But a particular drug may not be effective in all fishes. During the present investigation, yohimbine and atropine were found to have no apparent effect on the swimbladder or its gas contents in fishes studied, while dihydroergotamine and adrenaline were found to be very effective.

Dihydroergotamine injected intramuscularly, acts as an effective sympathicolytic agent on the swimbladder of *Ophicephalus marulius, O. punctatus* and *O. striatus*, as it causes marked increase in carbon dioxide and oxygen contents of their swimbladder, while it had no effect on the swimbladder or its gas contents in *Mastacembelus armatus* and *Colisa fasciata*. Atropine showed no effect on the swimbladder or its gas contents in any fish studied.

Intramuscular injection of adrenaline in *O. marulius, O. punctatus, O. striatus* and *Mastacembelus armatus* caused a marked decrease in carbon dioxide and oxygen contents of their swimbladder. In *Colisa fasciata*, however, only oxygen content of the swimbladder was lowered by adrenaline. Increase in carbon dioxide content after adrenaline in *Colisa fasciata* is probably due to lower rate of resorption of carbon dioxide in the fish, in absence of an efficient posterior resorptive chamber as in *Ophicephalus* and *Mastacembelus*. The inhibitory effect of adrenaline, however, on the gas secreting mechanism in the above fishes is clearly seen.

75. Surface activity in amoeboid sponge cells under the stress of different pH.

B. GANGULY, Calcutta.

The present experiment is in anticipation to have more information about the nature of movement undergone and morphological characteristics shown by amoeboid sponge cells in various pH conditions of the suspension fluid.

In a medium of normal pH (7·1), the amoeboid sponge cells throw broad pseudopodia at the rate of 6 to 8 per minute. Each pseudopodium is formed by the participation of both cell membrane and endoplasm, and surface activity continuous up to 4 to 6 hours in isolated condition.

A shift towards acidity (pH 4 & pH 6), retards the movement and to alkalinity (pH 8·5 & pH 9·5) first accelerates the surface activity but finally stops the mobility. The acid and alkali treated cells may be brought back to normal condition after reexposure to a suitable opposite pH. Experiments dealing with the treatment by opposite pH show three different trends—either (1) cells exhibit sign of recovery, or (2) cells continue to show effects of first pH or (3) the cells succumb immediately after changing to the exposure of second pH.

Possible mechanism of recovery in such cells has been discussed.

76. Excretion in Arachnids. I. Scorpion.

M. S. KANUNGO and S. C. BOHIDAR, Cuttack.

Chemical, spectrophotometric and paper chromatographic (ascending) tests were carried out to investigate the nature of the excreta of the scorpion, *Palamnaeus bengalensis*. The greyish-white excreta is soluble in dil. sodium carbonate and has a maximum absorption at 250 mμ. All the above tests have shown the presence of purines, adenine, hypoxanthine and uric acid. Guanine, in addition to all the above purines, was also detected in the excreta of the spider. It is considered that the animals excreting several intermediates of the same excretory cycle, for example, the scorpion and spider, are physiologically less evolved than those excreting only one intermediate of the same cycle, for example, the insects which excrete only one purine, uric acid.

77. Changes in the localisation of alkaline phosphatase due to centrifugation in *Acanthamoeba* sp.

D. MUKHERJI, Calcutta.

Trophic forms of *Acanthamoeba* sp. were centrifuged for different time intervals and these were subjected to cytochemical tests to ascertain the nature of sedimentation produced. Localisation of alkaline phosphatase was closely followed till 48 hours after centrifugation. It has been observed that the centrifuged amoebae show alkaline phosphatase positive granules mobilised at the periphery. These phosphatase positive granules are often condensed as channels radiating from the nucleus to the periphery.

Localisation of alkaline phosphatase in centrifuged amoebae reveals that a degree of differential sedimentation results in cytoplasm which becomes rarely perceptible in amoebae processed by ordinary way.

78. Physiological trends in Janus green B treated cells.

SIVATOSH MOOKERJEE, M. CHOUDHURY and B. GANGULY, Calcutta.

In the present set of experiments, the reducing ability of a supravital stain, Janus green B by amoeboid cells in sponges has been studied under the impact of different pH and temperature gradients.

A concentration of Janus green B solution over 0·2% immediately disintegrates the cell. Lesser percentages have other physiological effects. However, concentration of 0·006% has no adverse effects in the cells. In the last solution the colouration of the granules remains for 30 to 45 minutes, after when it is reduced. The general trend of results in various concentrations in between 0·2% and 0·006% show the following features: (1) Enlargement in cell size, (2) cessation of cytoplasmic movement with thickening of cell membrane, (3) development of a number of vacuoles in peripheral region with numerous particles in them.

Exposure to different experimental conditions, i.e., in high and low temperature and pH, neutralises the above mentioned effects of Janus green B.

In treated cells, as soon as vacuoles develop, surface movement ceases. Disappearance of vacuoles makes the movement returned to the cell. Vacuoles stand in the way between plasma membrane and cytoplasm and free interplay of surface is prevented.

79. Cell lineage in Nucleic acid treated amoebae.

SIVATOSH MOOKERJEE and JAYANTA K. DATTA, Calcutta.

Inside the nucleus, DNA, the most stable molecular content, has not only the overall control over all jurisdiction of a cell but also its subsequent progenies. DNA is modifiable under a host of extraneous sources like X'rays, chemical mutagen, etc. Here is an attempt to expose the trophic forms of amoebae to the effects of nucleic acids of thymus and yeast. The chief significance of the experiment is to observe how does the self-perpetuating model of a cell, as typified in amoeba, react to the action of nucleic acids and form subsequently its own cell lineage.

The effects of nucleic acids on amoeba are important for more than one counts. It induces almost immediately higher granulation in cytoplasm, thickening of cell surface and occurrence of higher vacuolisation. The thickening of the surface takes place in such a way that soon cell membrane becomes immobilised and gives a false impression of an encysted condition. Such changes are observed in amoebae originating after divisions from the ones treated before with nucleic acids. Such trends linger on in trophic forms for two to three subcultures. In each subculture, there is a few hundred division of original trophic forms, i.e., the nucleic acid-induced-changes persist in daughter cells. However, by repeated subculture for more number of times, physiologically altered stake in amoeba can be got rid of. But repeated treatment with nucleic acid in consecutive subculture 'kills' the organism.

The implication of the transient structural changes in amoeba brought about in the cell body as a result of nucleic acid treatment has been discussed in the light of DNA permanency and cell lineage.

80. Cytochemical changes in relation to synthetic activity in fatbody cells.

SIVATOSH MOOKERJEE and AJAY KUMAR RAY, Calcutta.

Cytochemical configuration of fatbody cells of *Periplaneta* has been investigated in normal and experimental conditions. Animals were first starved and the fatbody tissues were fixed on the 7th, 14th, and 21st day of starvation. After 21 days, they were fed with protein and carbohydrate diet separately and fat body cells were fixed after 2, 3, 4 and 5 days. Starvation results in progressive depletion of cytoplasmic basophilia, condensation of chromatin material, discontinuity of nuclear membrane, loss of Feulgen stainability and fragmentation and disorganisation of nucleolus. Feeding leads to gradual recovery of the cytoplasm and nucleus to normal configuration. Recovery is more rapid after protein diet.

The significance of cytochemical changes has been discussed in relation to synthetic activity of the fat body cells.

81. Transient physiological changes in trypsinised amoebae.

S. MOOKERJEE and P. L. D. WAIDYASEKERA, Calcutta.

Physiological changes occur in cell body of amoeba originated by repeated treatment with 0·2% Bacto-trypsin. Cysts obtained after treatment, if subjected to successive subcultures, show certain physiological changes in trophic forms in having about double the volume of the cell, occurrence of more vacuoles, and 'unequal divisions'. These changed physiological trends return to normalcy after 4th successive subculture. If retreatment by Bacto-trypsin is carried on in each subsequent subculture, emergent amoebae tend to minimise their size, and ultimately by the 4th retreatment, they become non-viable and no more subculture is possible from the cysts formed out of them.

The aspect, related to the question of amoebae becoming normal after the first treatment by repeated subculture, has been followed in detail. Two kinds of amoebae formed by the 'unequal division' show difference in basophilic localisation; the denser is the smaller and the lighter one is the larger. The cutting of giant amoebae into unequal halves seems the major mechanism of returning the trophic forms into normal condition. Cell division, as it is understood, is under the control of nucleus. One can advance on the basis of the present result that the effects of 0·2% Bacto-trypsin in trophic amoebae seem to be of a transient nature, because the effects are regularised by some compensating mechanism possibly originating from nucleus which is eventually transacted into cytoplasm.

82. Occurrence of a Hypoglycemic factor in the eyestalks of freshwater crab, *Paratelphusa jacquemontii* (Rathbun).

P. V. RANGNEKAR and P. B. SABNIS, Amravati.

1. Extirpation of eyestalks results in a rise in the sugar concentration of blood, when compared with sham operated controls.
2. Injection of eyestalk extract in eyestalkless animals lowers blood sugar level considerably. This fall in the concentration in the blood sugar represents a hypoglycemic condition. In the control experiment injection of equivalent quantity of saline in eyestalkless crabs shows a rise in blood sugar concentrations as expected.
3. Injection of eyestalks extract in intact animals results in a remarkable fall in blood sugar level and the effect is all the more striking than that observed in eyestalkless animals. In the control experiment injection of equivalent quantity of saline had no significant effect on blood sugar level.
4. The amounts of free glucose in hepatopancreas, however, showed some interesting changes under different conditions. Thus, after removal of eyestalks the glucose concentration was lowered. It remained almost at a normal level after administration of eyestalk extract in eyestalkless animals as well as in

those with eyestalks. This suggests that there is a mobilization of free glucose in hepatopancreas following ablation of eyestalks. Eyestalk principle has no significant effect on glycogen level.

5. The action of hypoglycemic factor is analogous to that of insulin on blood sugar concentration in higher vertebrates. Our experiments lead to a more specific localization of a hypoglycemic factor in the eyestalks.

83. Cellular source in hydroid regeneration.

SOMES SANYAL, Calcutta.

The cellular source in regenerating structures of hydroids has not yet been settled. A survey of the changes in total cell population of three cell-types *viz.* epitheliomuscular, interstitial and cnidoblast in ectoderm during hydranth regeneration in *Hydra vulgaris* has been undertaken. The total counts show that overall cell population does not increase during regeneration; on the contrary, there occurs a sharp decline in the number of cells participating in the reconstitution of the pattern. Most conspicuous is the loss of interstitial cells and to a lesser extent of epitheliomuscular cells during first 24 hours after amputation. A little loss is also encountered during 24-48 hours. The total population of cells becomes more or less stabilized as regeneration nears completion during 48-72 hours. However, the number of cnidoblasts are gradually increased during the entire process.

It is attributed that regeneration involves remodellling of the available material and that interstitial cells do not differentiate into other cell-types except cnidoblasts during regeneration.

84. A causal analysis of morphogenesis of Hydra during bud development.

SOMES SANYAL, Calcutta.

This work has been designed to study the morphogenetic basis of determination and individuation in bud development of hydra. Three sets of experiments have been performed, first, the bud portion protruding from the parent hydra in the different stages of development have been explanted; secondly, the parent hydranth and stem distal to the bud have been removed and lastly, segments from different levels of an early stage bud have been isolated. Developmental fates of explants and the parent hydras and their time sequence compared to the control show that a bud originates as a radially determined area, in which the presumptive hypostome, tentacles, stem and basal disc are already determined at the early stage and occupy successive radial segments centrifugally from the centre. Ability of a developing bud to replace the distal parts of the parent hydra is dependent upon the nature of determination of its basal disc. Regenerative potencies at the different levels of an early bud correspond to the same of an adult hydra and actual regeneration does not occur until the bud development is complete. Individuation of the bud into an adult hydra becomes expressive as the developmental potencies of the differentially determined bud area are realised.

85. Distribution of some histochemically demonstrable cytoplasmic constituents in the kidney of Lizard.

C. SARKAR and C. DEB, Calcutta.

The distribution of some histochemically demonstrable cytoplasmic constituents has been studied both in the proximal and distal tubules of the kidney of garden lizard.

Succinic dehydrogenase, glucose-6-phosphatase and acid phosphatase in proximal convoluted tubules of lizard were similar to mammals but it contained lesser amounts of esterase, plasmalogen, alkaline phosphatase and P. A. Schiff positive substances (not glycogen). Most of the constituents were present in the distal convoluted tubules in a lesser amount, excepting acid phosphatase which was of much higher concentration. The apical portion of the cells of the distal tubule conntained considerable amounts of unsaturated lipids and lipase but not esterase. R.N.A., both total and some individual amino acids were also present in this portion in a lower concentration. It has been observed previously that the concentration of different cytoplasmic constituents in kidney is related to its functional activity. The observed changes in the kidney of lizard also suggests a difference in function compared to mammals.

86. Host-graft interaction in the determination of implanted material in Hydra.

ARUP SINHA, Calcutta.

Recently Mookerjee has shown that implantation of middle piece at the anterior level of another hydra results in the production of a basal disc and a hypostome at the posterior region, and the visual appearance of differentiation in the implant is seen after the lapse of 48 hours of experiment. The above demonstration was put to further experimental test to analyse the factors involved in the latent period of tissue interaction Three experiments were designed :

Experiment I : Excision of a portion of the implant
Experiment II : Excision of whole of the implant
Experiment III : Excision of the implant with equal amount of the host tissue.

All these experiments are performed at 24 hours' as well as 48 hours' stages and the excised portions are used as explants and cultured independently.

The explants in experiment I and II develop into a miniature hydra at 24 hours' stage but at 48 hours' stage they round up and show stickiness The explants of both the stages in experiment III develop into miniature hydras. But they are qualitatively different. In 24 hours' stage the anterior half including the hydranth is contributed by the implant and the posterior half including the basal disc is contributed by the host tissue, whereas in 48 hours' stage the case is just reverse. The findings establish the duration of a latent time period required for channelising the determination which is again dependent upon host-graft relation.

87. Histochemical study of Alkaline Phosphatase and Glycogen in the alimentary canal of certain Fish in relation to differences in their feeding habits.

ANIL KUMAR SRIVASTAVA, Gorakhpur.

Mastacembelus pancatus, a herbivore, *Heteropneustes fossilis*, an omnivore and *Ophicephalus striatus*, a carnivorous fish have been used for the histochemical study of Alkaline phosphatase and Glycogen.

Alkaline phosphatase occur abundantly in the free border of the absorptive cells of these fishes. In *Heteropneustes* and *Ophicephalus* the staining intensity decreases in the rectal region. *Mastacembelus* shows no enzyme in the rectum. The fibres in the subepithelial connective tissue also show phosphatase activity. *Heteropneustes* and *Mastacembelus* show positive results in granular cells. In *Ophicephalus* the stratum compactum contains alkaline phosphatase.

Pharynx, esophagus, stomach contain this enzyme; its intensity being the greatest in the basal layer of the stratified epithelium.

Glycogen was found scanty in the absorptive cells; it being absent in the stomach altogether. Granular cells of *Heteropneustes* and *Mastacembelus* contain glycogen; Ophicephalus gives negative results.

The investigation throws light on the absorptive function of alkaline phosphatase. It possibly absorbs glucose. Glycogen-localization closely follows the distribution of alkaline phosphatase (*viz.* in *Heteropneustes* and *Mastacembelus*). Therefore, glycogen-formation, perhaps, depends upon the dephosphorylation of hexose phosphate and the condensation of hexose molecules to form glycogen. Alkaline phosphatase might well be concerned in this dephosphorylation-process and so be concerned in the deposition of glycogen.

FISHERIES

88. Observations on the possibilities of inducing Pearl-formation in the freshwater bivalve, *Lamellidens lamellidens.*

K. H. ALIKUNHI, Cuttack.

Production of culture pearls by utilising the marine pearl oyster, *Pinctada martensii* is a flourishing industry in Japan. The large freshwater clam *Hyriopsis schlegelii* is also employed for producing pearls.

Lamellidens lamellidens is one of the common bivalves in Indian freshwaters and occurs in abundance in fish ponds at Cuttack. Certain preliminary experiments were carried out to find out whether pearl production could be induced in this species.

Shells conditioned for two weeks were operated and mantle grafts were introduced in the visceral mass. The operated shells were kept in wire-net trays in ponds for varying periods. 6 to 12 months after the operation almost all the surviving shells were found to have produced golden pearl-like concretion of various shapes at the places where mantle grafts were introduced. Further observations are in progress.

89. Fecundity, Breeding and life-history of a minor carp Labeo boga (Hamilton).

K. H. ALIKUNHI, S. PARESMASWARAN and K. K. SUKUMARAN,

Cuttack.

Labeo boga is one of the minor carps that commonly occurs in the carp spawn collected from the Mahanadi. In ponds it attains maturity when it is about one year old. Specimens 15 cms. or above in length are found with ripe gonads during June-July. Fecundity counts of 25 specimens ranging from 15·1 to 24·0 cm. in length show that the number of ovarian eggs ranges from 11,670 to 1,13,900.

Like other Indian carps *L. boga* also does not ordinarily breed in ponds. Ripe specimens were repeatedly induced to breed by intra-muscular injections of Rohu pituitary glands at a minimal dose of 7·6 mg./lb. for female and 6 mg./lb. per male. In hapas fixed in pond, the fishes spawned, 6-8 hours after the injection. Percentage of fertilisation of eggs ranged from 81·5 to over 92. The fully swollen, developing egg has a maximum outer diameter of 3·0 mm., the egg proper measuring 0·95 to 0·997 mm. in diameter. Cleavage commences within half an hour of fertilization and embryo is indicated within the next four hours. 8 hours old embryo shows occasional twitching movement. 14 to 17 hours after fertilization the embryo hatches out. The hatching, about 3·75 mm. long, has the yolk almost completely absorbed in about 24 hours, in the pond. In Laboratory aquaria the larva has all the fins fully differentiated in about 12 days after hatching.

90. Preliminary observations on Chinese Carps in India.

K. H. ALIKUNHI and K. K. SUKUMARAN, Cuttack.

An experimental consignment of 360 fingerlings of the Chinese Silver carp, *Hypophthalmichthys molitrix* was brought from Tokyo to Cuttack on 1st September 1959 and a similar consignment of 382 fingerlings of the Chinese grass carp, *Ctenopharyngodon idellus* was brought from Hong Kong on 22nd December 1959. Observations made on these exotic, quick growing major carps during the last 22 months are briefly discussed in this paper.

Silver carp is a plankton feeder and preliminary observations on its growth in ponds indicate that it is decidedly faster than that of *Catla catla,* the fastest growing Indian carp. Sexual maturity is attained, at Cuttack, when the fish is just two years old. Marked roughness of the outer surface of the pectoral fin distinguishes the ripe male from the female. Two years old fish have attained an average weight of 4·5 Kgs., the maximum observed being 6·5 Kgs.

The grass carp feeds voraciously on aquatic weeds. *Hydrilla, Lemna, Azolla, Lagerosiphon* etc. are particularly favoured. Preliminary experiments indicate that nursery ponds choked with *Hydrilla* can be completely cleared of weeds in the course of a month by introducing 25-30 cms. long grass carps at the rate of 100 to 150 per acre. Two years old males weighing 2 to 3 Kgs. were sexually ripe and oozing but the females (2·5 Kg. to 3·5 Kgs.) were not mature.

91. Some Observations on the Pollution at Okhla Water Works Intake, Delhi.

MOHAN C. BALANI, and H. L. SARKAR, Delhi.

In the present paper an attempt has been made to determine the extent of pollution at Okhla Water Works Intake, during the monsoon months. The Okhla Water Works whose capacity is 3 MGD is situated on the downstream of the river Jumna and suffers a good deal of pollution.

Barapulla nallah is one of the thirteen nallahas of Delhi and drains the sewage of the major portion of South Delhi, in the river Jumna, hardly two furlongs down the Okhla Weir. The nallah has strong mud embankments and is about 15 miles in length with an average 5′-6′ width and 1′-2′ depth. The velocity of the effluent in the nallah varies between 0·5′-2·0′ per second. The effluent in its normal flow, after passing beneath the Agra irrigational canal, is discharged in the river Jumna down the Okhla Weir. During the monsoon months, sewage of the nallah cannot pass through the narrow channel leading to its normal course. It thus takes straight course towards the river Jumna. A *kuchha bund* erected to prevent the sewage flow in the river, gives way during the monsoon months, with the result the effluent is carried into the river Jumna, hardly 40 yards upstream of the Okhla Water Works Intake, situated on the same bank.

Physico-chemical observations like turbidity, pH, dissolved oxygen, chloride, free ammonia, and albuminoid ammonia were carried out in the months of July, August and September 1960 at three spots, i.e., Barapulla nallah, Okhla Intake and upstream. The data collected have revealed that the water pumped from the Intake shows pollution due to the overflow of the Barapulla nallah.

Care must be taken by the municipal authorities to stop the pollution of the Intake water during the monsoon months.

92. Soil nutrients and plankton production in fish ponds. A. Available Soil phosphorus.

S. M. BANERJEA and A. N. GHOSH, Cuttack.

Bottom soil in a pond appears to act as a reservoir of nutrient elements like nitrogen, phosphorus, potassium, calcium etc. wherefrom they are supplied to the water. The quantity of plankton, which forms an important link in the food cycle for fish, is largely determined by the availability of these elements from the soil to the water. So, a study of possible relationships between different levels of available nutrients in the bottom soil and plankton production was considered necessary to determine a judicious programme of fertilisation for fish ponds. As phosphorus is known to play a dominant role, the effect of increasing the available phosphorus content in a phosphorus deficient soil which was sandy in texture and slightly acidic in reaction, on plankton production was studied both in the laboratory as well as in the field. The available phosphorus content (40 p.p.m. P_2O_5) was initially raised to three different levels of 80,120 and 160 p.p.m. in the laboratory experiment and to 80 p.p.m. only for the field experiment, by adding the requisite quantity of double superphosphate (32% P_2O_5). A progressive increase in plankton concentration for the different increased levels of available phosphorus in soil was observed both in the laboratory and in the field experiments which continued for 12 and 6 months respectively. In this particular soil-type with low total nitrogen of which more than 60% was present in the available form maximum production of plankton was obtained when the ratio of available nitrogen : available phosphorus was approximately one.

93. Studies on the biology of the Goby, *Glossogobius giuris* (Hamilton).

R. M. BHOWMICK, Barrackpore.

Study of the length-weight relationship of over 1288 specimens revealed the following : In male $W = 10 - 5 \times 0{\cdot}87338\ L^{2{\cdot}9854}$. In females $W = 10 - 5 \times 0{\cdot}91381\ L^{3{\cdot}0457}$. In specimens over 85 mm. length the males are distinguished from the females by the relatively long, thin genital papilla.

Just over 20% of the females mature at a total length of 76 mm. percentage of maturity gradually increases with increase in size and all females measuring 186 mm. and above are mature. The various stages of maturity have been described.

It is found that juveniles have preference for crustacean food, especially copepods. Large specimens 90 mm. or above do not show such preference for copepods. They are omnivorous in habit, showing marked preference for fishes and prawns. Cannibalistic tendency is not found to be pronounced.

Fully mature specimens are obtained almost throughout the year but the peak period of breeding is from August to October. Fecundity increases with the increase in size. Number of ovarian eggs varies from 1·9 lakhs to 6·5 lakhs in specimens ranging from 11 cm. to 24 cm. in total length.

In the Hooghly estuary (Nabadwip area) during the month of February about 12·5 maunds of *G. giuris* are landed, contributing 21% of the miscellaneous fishes caught.

A new type of fishing net with a scare-line for catching bottom fishes especially gobies, has also been described.

94. Fish culture in a swamp in Chetpat, Madras City.

P. I. CHACKO and J. G. ABRAHAM, Madras.

A typical swamp overgrown with vegetation and containing predators, is utilised for systematic fish culture on a phased programme. Water-area is 10 acres in extent, and depth ranges from 1 to 10 feet. Plankton consists of diatoms, algae, copepods, daphnids and rotifers. Range of temperature of water is 27·5-37·2°C at surface and 26·2-36·5°C at bottom. Quantity of fish landed and marketed has been 1552 lbs. in 1955-56, 2133 lbs. in 1956-57, 2644 lbs. in 1957-58, 5124 lbs. in 1958-59, 6767 lbs. in 1959-60 and 6831 lbs. in 1960-61, thus increasing the annual fish production from 155·2 to 683·1 lbs. per acre. Important forms contributing to the fishery in order of abundance are *Tilapia mossambica, Catla catla, Ophicephalus striatus, Cirrhina reba, Labeo fimbriatus, Labeo rohita, Etroplus suratensis, Chanos chanos, Cirrhina cirrhosa, Notopterus notopterus and Mugil cephalus.* Of these *Tilapia* formed 82 per cent of the landings in 1960-61. Swampy waters appear to be suitable for this fish. It averaged 3-5 inches in size and 2 ounces in weight.

95. An unusual drifting of *Glaucus marinus* (Du Pont) from the Bay of Bengal into the Ennore river near Madras.

P. I. CHACKO and A. RAJAGOPAL, Madras.

Glaucus marinus is a pelagic nudibranch occurring in the Bay of Bengal. It is 30-50 mm. in length. It floats on its back and its upturned blue ventral surface simulates with the marine environment. Though thrown up along Madras beach occasionally, an unprecedented instance of innumeral specimens of this species getting drifted into the Ennore river-estuary occurred on 28-29 December 1960. They were thrown along the southern shore of the river to form a belt one kilometre long and one metre wide with a density of 200 specimens per square metre. Following few days of cyclonic weather conditions, these nudibranchs appear to have got congregated into a mass by a depression and whirlpool in the Bay and then drifted towards the shore by current and then cast into the river during high tide. The low salinity of 17·32 parts per thousand of the estuary water would have caused mortality. This instance is a typical example of the influence of weather and oceanographic conditions on life and survival of marine organisms.

96. Hydrobiology and fisheries of the Ennore river, near Madras from April 1960 to March 1961.

P. I. CHACKO and A. RAJAGOPAL, Madras.

The estuarine region of river extended to 12 furlongs in length and 4 furlongs in width. Depth of water was 3 to 5 feet. It had connection with the sea from November to March. Rainfall, humidity and atmospheric temperature was 42·15 inches, 51-96 per cent and 24·0-36·5°C. Surface water temperature, specific gravity, pH and salinity were 28·5-35·0°C, 1,000-1·028; 7·4-8·9 and 0·2-46·7 p.p. 1000. Plankton sedimentation was 1·0-500 cc per litre of 20 minutes haulage. *Coscinodiscus, Rhizosolenia,* copepods, nauphii, larvae, zoea larvae, megalopa larvae and larval prawns were common. Fishery totalled 255 tons. Mullets were 40% of langings. Cat fishes, Silver bellies, Horse-mackerals, Gizzard shad, Whiting, pearl spot, squeaking perch, Silver perch, prawns and crabs were the other main fisheries.

97. Further observations on the breeding of Milk-fish, *Chanos chanos* in the inshore waters of Rameswaram.

P. I. CHACKO and S. DAVIDSON THOMAS, Madras.

In the course of operation of bottom-set gill nets made of nylon twine of 50-60 lbs breaking strength and of 5, 6 & 7 inches mesh in inshore waters off Rameswaram in 1960, large specimens of Chanos were obtained during all months except in February. Depth of fishing grounds was 3-4½ fathoms and their bottom were sandy. The specimens ranged from 28 to 36 inches in size and 6·40 to 8·66 lbs. in weight. There were two peak periods of occurrence in May-June and in November, when the female specimens were gravid. Some specimens obtained in June, July, November and December were spent ones. These observations confirm that adult chanos occurs in the bottom waters of the inshore area and breed close to tidal creeks and mud flats twice a year..

98. Breeding of *Puntius sarana* (Hamilton) and observations of its life-history and bionomics.

HIRALAL CHAUDHURI, Cuttack.

Puntius sarana (Hamilton) like other major and medium-sized Indian carps does not ordinarily breed in confined waters. The author has successfully induced this species to breed repeatedly by injection of fish pituitary extracts. It has also been possible to make it breed in a small pond by maintaining a flow of accumulated rain water without any injection.

A complete account of the life-history is included in the paper. Developing eggs are demersal, range in size from 1·2-1·4 mm. in diameter and hatch out within 13-17 hours. Distinguishing characters of the larvae, post-larvae, fry and fingerlings have been described. The food and feeding habits of the fish have been discussed.

99. Breeding and life-history of *Rasbora elanga* (Hamilton).

HIRALAL CHAUDHURI, Cuttack.

Rasbora elanga (Hamilton) attaining a length of 20 cm. or above is an esteemed food fish in Bengal, Assam and Burma. Like other Indian carps is does not breed in ponds.

The fish was bred by injection of fish pituitary hormones. The fertilised eggs swell up considerably and are non-adhesive and demersal in nature like the eggs of major carps. The average diameter of the egg is about 2·7 mm. The yolk has a slight orange tinge. The newly hatched larva measures about 4·4 mm. in total length. The hatchings were reared in the laboratory up to the fingering stage and various stages of life-history studied in detail. Adult characters are attained in the course of 10 days after hatching.

Characters distinguishing sex of breeders are also described.

100. Induced breeding and development of a common Catfish, *Ompok bimaculatus* (Bloch).

HIRALAL CHAUDHURI, Cuttack.

The paper gives a complete account of the life-history of the widely distributed catfish *Ompok bimaculatus* (Bloch). The species was successfully bred in cisterns by injection of carp pituitary extract and the developmental stages were studied in detail. The eggs are reddish-brown in colour, non-adhesive, demersal and measure about 2·0 mm. in diameter. They hatch out within 14—17 hours after fertilisation. About six hours after hatching, a sticky substance is secreted by the hatchlings from the ventral region of the yolk mass. By means of this secretion they stick on to some substratum and constantly move their head and tail sideways. The hatchlings were reared in the laboratory and thereafter in ponds to fingerling stage. Adult characters are attained in the course of 15 days after hatching.

The characters distinguished sexes during the breeding season have also been described.

101. Observations on induced breeding of major Indian carps during 1960 at Cuttack.

H. CHAUDHURI, R. M. BHOWMICK, R. N. PAL and A. B. MUNSHI,
Cuttack.

Experiments carried out at Cuttack during June to September, 1960, on induced breeding of Indian carps by pituitary hormone injections are described.

116 sets (a set consists of one female and two males) of major carp breeders (*Catla, Rohu, Mrigal* and *Calbasu*) were injected with 60% successful results. Spawning was partial in a few cases. In the majority of successful spawnings, the percentage of fertilisation of eggs was over 70, the maximum being 98·5.

Intramuscular, homoplastic injections were administered in the majority of cases. Spawning occurred after one, two or rarely three injections. For breeders ranging from 0·01 Kg. to 5·9 Kg. the successful dose of single injection ranged from 0·2 to 1·5 glands for females and 0·05 to 0·9 glands for males. When two injections were required the total dose ranged as follows :

Males	0·15 to 1·3 glands
Females	0· 3 to 3·0 glands

The injected breeders were released in cloth *hapas* fixed either in ponds or in the river. Developing eggs were hatched out inside a double hatching *hapa*. About 82 lakhs spawn were stocked in nursery ponds on the third day of hatching.

The paper includes details of the breeding and hatching techniques followed.

102. Observations on the utilisation of food by the major carps.

M. G. GEORGE, Delhi.

The observations on the utilisation of the food in *Labeo rohita, Catla catla, Cirrhina mrigala* and *Labeo calbasu* have revealed that all the food items that are consumed are not of equal importance to the fishes. The blue-green algae, euglenoids and fungal spores are not utilised by the fishes as they reappear fresh in the hindgut. It was surprising to find that among the green algae, filamentous forms like *Oedogonium* and *Spirogyra* were digested by the fishes, while some of the smaller forms like *Scenedesmus* and *Kirchneriella* were not acted upon by the digestive enzymes. However, it has not been possible to find whether the fishes were feeding on the senescnt filaments of the algae in which case digestion may be easy. The diatoms are digested by the fishes as only broken shells were noticed in the hindgut. Thus among the major algal groups, only the members of Bacillariophyceae were digested. Whenever zooplankton were taken, they were digested.

Since many of the algae pass through the ailmentary canal undigested, it is quite likely that these algae may be appearing again as the standing crop of plankton. Also the selective digestibility may have a profound effect on the composition of plankton.

103. Growth and propagation of Common carp *(Cyprinus carpio)* in India. IV. Observations on the size of eggs, hatchlings and fry of parents of various size.

K. V. RAMAKRISHNA and K. H. ALIKUNHI, Cuttack.

In India the Common carp (*C. carpio. var. communis*) starts breeding when it attains a length of 18 to 20 cms. Mature specimens ranging from 0·12 Kg. to 6·0 Kg. and over are used in experimental and commercial breeding.

Detailed observations on the size of eggs laid by and the length of hatching and fry obtained from breeders of various size were made and it was found that generally the eggs of smaller specimens are smaller than those of larger ones. The same trend was observed in the case of hatchlings and fry also.

The size of hatchlings and fry varied when eggs from the same batch were hatched in different habitats.

Rearing fry of specimens of widely different size, under identical conditions in the laboratory indicate that fry of the bigger fishes maintain their initial size advantage at least during the early rearing period.

The significance of these findings in practical fish culture are discussed.

104. Physico-chemical and Biological conditions in selected paddy fields in Orissa, with special reference to fish culture.

G. N. SAHA and K. V. RAMAKRISHNA, Cuttack.

An assessment survey of paddy fields as an environment for fish culture was conducted in Cuttack, Puri, Ganjam and Sambalpur districts of Orissa. Fluctuations in water, soil and plankton conditions in 26 plots (15 under winter paddy and 11 under summer crop) selected at random were periodically studied for one year.

Plankton in all the plots was relatively poor. Zoo-plankters like *Cyclops, Nauplii, Brachionus* and *Polyarthra* predominated. *Euglena* and *Peridinium* were common. Phytoplankton blooms were rarely met with.

Water and soil conditions do not seem to permit rating paddy fields as a productive habitat for fish, particularly plankton feeders. The paucity of plankton in the field is probably the result of paddy plants thriving there, as an emergent macro-vegetation for the aquatic phase.

105. Observations on biology of the two species of diaptomids, *Heliodiaptomus viduus* Gurney and *Neodiaptomus strigilipes* Gurney commonly occurring in fish ponds at Cuttack.

K. L. SEHGAL, Cuttack.

The paper deals with observations made on the biology of two species of diaptomids, H. *viduus* and N. *strigilipes*. The gut analysis of 174 specimens of H. *viduus* and 153 specimens of N. *strigilipes*, collected round the year from nursery ponds at Cuttack indicates that they feed mainly on microscopic algae, diatoms, protozoans and rotifers. The composition of food on the average has been found to be as Myxophyceae—70·0%; Bacillariophyceae—14·0%; Euglenineae—4·1%; Chlorophyceae—1·9%; Protozoa—7·0% and Rotifera 3·0%. Culture experiments carried out under laboratory conditions suggest that temperature has some role to play in the rate of reproduction and survival of nauplii and copepodids. Use of organic manure was found to enhance propagation of the two species. The number of eggs in a sac ranged from 9-29 in H. *viduus* and 7-24 in N. *strigilipes*. Average diameter of eggs before hatching has been measured as 0·061 mm. in *H. viduus* and 0·045 mm. in N. *strigilipes*. The hatching of eggs was by osmotic swelling of the inner egg membrane which takes place 4-6 hours prior to liberation of nauplii. The hatching of the eggs was not simultaneous. They hatched in batches of two or three. There are six naupliar and five copepodid stages during development. H. *viduus* took 96-112 hours to complete the six naupliar stages and 10-15 days to complete the whole life-history. N. *strigilipes* required 91-103 hours for six nauplii and 8-13 days to complete the life cycle.

106. Observations on the Biology of *Oxygaster gora* (Hamilton) at Allahabad, Uttar Pradesh.

K. L. SEHGAL and S. B. SINGH, Cuttack.

Oxygaster gora (Hamilton) attains a length of 27·0 cm. or above in the rivers Ganga and Jamuna at Allahabad. The length-weight relationship was found to be in a straight line and in the specimens up to 17-19 cm. sixe-group, the increase in weight was at a slower rate than in the subsequent size-groups. Detailed analysis of the gut contents of over 90 specimens indicated the average composition of diet as fish—67·5%, insects—26·6%, Crustaceans—3·8%, and algae—2·1%. The intensity of feed was moderate during winter and summer months but was poor in rainy season. Study of maturity and spawning indicated that the fish matured during March to June and the peak spawning season was from April to May. In the ovaries of fully mature females of average length, 22·1 cm. 23,000 eggs were counted. The sex ratio of males to females was 1 : 2 and the males were smaller in size than the females. The post-larvae and juveniles were found in abundance in the two rivers from April to July.

107. Control of some emergent and floating water weeds by Taficide-80.

S. B. SINGH, Cuttack.

Taficide-80 and 80% Sodium salt of 2, 4-dichlorophenoxy acetic acid, @ 5·6 Kg./hect. has been found effective in the control of *Nelumbium speciosum* Willd. (Lotus), *Euryale ferox* Salisb. (prickly water lily), *Nymphaea* spp. (Water lily) and *Eichhornia crassipes* Solms. (Water hyacinth) in fishery waters. With proper coverage and in the absence of rains complete kill of sprayed leaves is obtained within three to seven weeks' time. A second treatment after two to three weeks in th case of lilies and lotus, to kill any new leaves that might have been renewed from the bottom, frequently results in permanent clearance. This is not required in the case of *Euryale* where the leaves are large, corrugated, without waxy coating, and the chemical does not get easily washed off. Complete clearance of the plants with one treatment in some of the trials probably suggests that the chemlical is translocated to the underground part as well.

The cost of chemical required for a single treatment in the case of the above weeds worked out to Rs. 44/- per hectare.

In experiments on *Pistia stratiotes* Linn. (Water lettuce) complete kill of the plants was obtained @ 11·2 Kg./hect. and 5·6 Kg. hect. in four weeks' time in cement cisterns during bright weather and with uniform spraying, but not in the field probably owing to rains and other reasons.

108. Two cases of discolouration of Squids.

A. SREENIVASAN, Bhavanisagar.

The squid, *Omnastrephes sloani pacificus* forms a high percentage in the fish catches of Japan. Its preservation is therefore of importance. In one case the squid treated with O.T.C. (terramycin) and stored at ice-temperature was found to develop a yellow discolouration. This was traced to a bacterium resembling *Pseudomonas pulida.* This culture tolerated a concentration of 100 p.p.m. of O.T.C. This was a psychrophilic organism reducing trimethylamine oxide. The second instance of discolouration was caused by a species of Serratia, but this occurred at temperature above 25°C, the squid turning red by the growth of this organism. But this failed to occur at 4°C and the bacterium itself failed to grow at this temperature. This culture tolerated 400 p.p.m. of O.T.C. Tolerance of such high concentration of the antibiotic is interesting, since the greatest amount tolerated by *Serratia marcescens* is only 200 p.p.m. as reported by Castell (1959).

109. Fat Variation in a Fresh Water Fish, Labeo fimbriatus.

A. SRINIVASAN and R. SOUNDERARAJ, Bhavanisagar.

In migratory marine fishes, variation of fat with season and sexual maturity has been noted but as regards fresh water fishes information is taking. *Labeo Fimbriatus,* which was introduced into the Bhavanisagar Reservoir from Cauvery, has grown well and it occurs regularly in the experimental fishing catches. Periodical analysis of the fat, moisture and protein of this fish has been carried out since January 1961. The fat content does not show any seasonal pattern. Size also does not seem to infiuence the fat content of the flesh. Nor is the fat content corrected with the "condition factor". In the case of female fish of the fat does not increase with increasing maturity. For instance females in the fifth stage had as low a fat content as 1·61% and 1·63% respectively on two occasions while a female in the first stage of maturity had fat content of 6·68%. In the male fish however there were indications of increased fat content with increasing maturity, and this appeared to have a seasonal pattern. Instead of an inverse correlation of fat and moisture, very peculiarly, there appeared an inverse coorrelation of fat with protein, the latter decreasing with increasing fat content in the male. These results differ in some respects with these for *Barbus dubius, Wallago attu* and *Macrones aor* (Sri Srinivasan and Natarajan 1961). Further results will indicate the exact trend of fat variation. The range of fat noted till now is 1·05 to 8·88% for sizes 1816 g. to 4767 g. of the fish.

110. Experiments on inducing spawning of Indian carps by injection of fish pituitary hormones during 1959 at Cuttack.

M. A. VIJAYALAKSHMANAN, R. N. PAL, K. K. SUKUMARAN and
K. V. RAMAKRISHNA, Cuttack.

Catala Catla, Labeo rohita and *Cirrhina mrigala* were successfully and repeatedly spawned by injection of fish pituitary hormones and about 3 million spawn were produced and stocked in nursery ponds for rearing.

Pituitary glands preserved at room temperature for 2-3 months were successfully used to induce spawing at doses comparable to glands preserved at low temperature. Pituitary glands of common carp (*Cyprinus carpio*) induced successful spawning in Rohu and Mrigal ; Rohou glands induced spawning in Catla, Rohu and Mrigal and similarly Mrigal glands in Rohu and Mrigal.

Some of the fishes responded to a single injection and spawned within 8 to 12 hours. Majority of specimens spawned after the second injection, within 24 hours; while a few of them spawned after the 3rd injection also. Spawning was induced in 51% of the breeders injected. Fertilisation of eggs in some was very low, while in others it was as high as 98%. Injected fish spawned at night as well as during daytime, in all types of weather conditions.

A Rohu female that spawned in 1958 and was sub-sequently kept separate in a pond developed gonads normally during 1959 when it was again bred by a single injection of hormones.

Details of injections given, number of eggs laid, percentage of fertilisation and hatching techniques applied are discussed in the paper.

HELMINTHOLOGY & PARASITOLOGY

111. Studies on pediculosis in goats kept on Vitamin A deficient feeds and restricted activity.

R. P. CHAUDHURI and PAVAN KUMAR, Izatnagar.

Some investigators think that vitamin A supply has a great influence on the pediculosis in animals; others do not agree to this view. It has also been reported that any interference with normal host activity tends to favour pediculosis. In order to study this problem an experiment was carried out to see the effect of vitamin A deficient feeds and lack of exercise on the pediculosis in goats. Four groups of goats of six individuals in the 1st year and ten in the 2nd year, all of the same age and the same breed were taken. One of the groups was having adequate ration with extra vitamin A added and restricted exercise i.e. always confined inside the stall; the second group was having vitamin A deficient ration but normal exercise. The third group of goats was having vitamin A deficient ration and restricted exercise and the fourth group had adequate ration with extra vitamin A added and the normal exercise.

The observation on the lice population on these groups of goats showed that the fourth group was the least infested and the third group the most infested of all. Of the two remaining groups the second was more infested with lice than the first. In other words, the population of lice was more on the goats kept on vitamin A deficient feeds and normal exercise than on those maintained on feeds with sufficient vitamin A supply and restricted exercise.

112. Studies on Biology of *Dictyocaulus filaria* (Metastrongylidae : Nematoda).

V. P. SHARMA DEORANI, Izatnagar.

The adult worms in tap water lived 24-30 hours at room temperature during summer and 2-3 days at room temperature during winter. The best development of the larval stages was achieved in tap water culture, provided adequate measures were taken. In tap water during winter the hatching of the larva took 2-3 days at room temperature and upto 24 hours at room tempertaure during summer. The second stage larva in tap water at room temperature during winter developed in 2-3 days after hatching, and in one day under similar conditions in summer. The third stage larva under similar conditions developed in 1-2 days after second stage in summer and 2-3 days in winter. The ensheathed infective larva was more actively motile than the previous stages and was more so in fresh liquid cultures. On the whole, in tap water at room temperature during summer the infective larva developed in 4-7 days after culturing and under similar conditions in 8-11 days during winter.

The first larva failed to hatch out in absence of moisture. Moisture was also essential for further development of the larva throughout the free living stages. The whole process of free living development of larvae was carried out at nearly 30°C. Except infective larvae which could survive at a temperature of 38—40°C for nearly 24—30 hours, the other stages died rapidly. When cultures were kept on ice the development was retarded. The infective larvae lived for 7 days in ice. The egg, first and second stage larvae did not withstand complete dessicataion for more than few minutes. However, the infective larvae possessed a greater ability to withstand it, and on drying they died in 5—30 minutes in summer and 1—2 hours in winter, at room temperature. The first, second and third stages did not migrate for and were not able to cross a height of 0·5 inches. The infective larvae though also showed poor negative geotropism, could cross a height of one inch. The migration of the larvae was generally at night and thus showed some sort of negative phototropism. For migration of the larvae moisture was also found to be essential.

The larvae lived for 1—3 hours in 1 :100,000 copper sulphate solution; ½—1½ hours in 1 :1000 phenyl solution; 1—2 hours in 1 :1000 Dettol solution; and 3—7 days in 1 in 4 faeces and urine culture. The earlier stages of the larva were more adversely affected.

113. Studies on the Biology of *Ogmocotyle indica* (Notocotylidae : Trematoda), Intestinal Trematode of Sheep and Goats.

V. P. SHARMA DEORANI, Izatnagar.

Out of 176 sheep and goats examined 51 were found positive for this infection. In endemic areas, which were generally at an altitude of 6,000 to 8,000 feet, the percentage of infection varied from 44 per cent at Barabaon, 45·4 per cent at Budher, 53·1 per cent at Gwaldam, to 53·8% at Deoban. Number of worms collected from individual cases varied from more than five thousand to more than two lakhs. The ratio of number of eggs voided per gram of host faeces to the number of worms present inside the host averaged 1 :3.

The worms lived 9—17 hours and 10—22 hrs. in water and normal saline respectively at room temperature during winter, and 4—9 hours and 8—14 hours in water and normal saline respectively at room temperature during summer. *In vivo* development of the egg was studied. The rounded eggs first become oval and then a spine like projection first develop at antopercular end. The operculum is demarcated at the other end from which also a spine arises. With the further development, the egg becomes asymmetrically oval and the spines then become unequal long filaments. Attempts to develop the eggs *in vitro* did not result in the development of the miracidia.

For natural infection of *Ogmocotyle indica,* 318 *Euaustenia cassida* and 52 *Limax* from endemic areas were examined, but none was found positive for this infection. Sixty-one clean *E. cassida* which were later fed on *O. indica* eggs, did not take the infection. Out of 397 aquatic snails of the genera *Vivipara. Lymnoea* and *Gyraulus* from the endemic areas examined for natural infection were not found positive for the infection. Twelve clean snails of the genera *Indoplanorbis, Lymnoea* and *Gyraulus* which were fed on *O. indica* eggs also did not pick up the infection.

114. Life-history studies of *Dictyocaulus Filaria* (Metastrongylidae : Nematoda).

V. P. SHARMA DEORANI, Izatnagar.

The characteristic first stage larva on emergence from the egg was actively motile and measured 0·548—0·582 × 0·019—0·023 mm. The first lethargus began in 12—48 hours after hatching. The second stage larva measured 0·531—0·585 × 0·023 mm. The second lethargus started 12—24 hours after second stage during summer and 24—48 hours during winter. The third stage larva was enclosed in two sheaths and measured 0·514—0·548 × 0·019 mm. The first ecdysis took place in one day's time after third stage, under room temperature in summer and 1—2 days' time during winter. The ensheathed infective larva was characteristic and measured 0·548—0·582 × 0·019 mm.

For studies on parasitic part of the life-cycle, infection was given to guinea-pigs with *D. filaria* infective larva. The unsheathed third stage larvae were found in mesenteric lymph glands from 2—7 days and fourth stage in lungs from third day onwards. In liver no larva was found. On infection by these larvae to kids, they were recovered from intestine upto second day, from mesenteric lymph glands upto 2—3 days and from lungs 7th day onwards. From their liver also no larva was recovered. The unsheathed larvae measured 0·565—0·582 × 0·02—0·023 mm. The fourth stage male larva measured 0·531—0·617 × 0·023—0·026 mm. and female fourth stage larva 0·891—0·943 × 0·030—0·034 mm.

The prepatent period of the infection varied from 39 to 47 days. Cross-infection of *D. filaria* infective larvae from sheep source to goat and from goat source to sheep did not show any significant difference in number of worms developed inside lungs of those hosts.

The results of present study do not support that the prenatal infection takes place in case of this infection. Restricted development of the worms was observed in animals that had previous experience of the infection.

115. On the larval form, hydatid cysts of *Echinococcus granuluosus* (Batsch, 1786) from the Sheep of Delhi State.

L. N. JOHRI, Delhi University.

In course of a survey of helminth parasites from Delhi slaughter houses, the occurrence of the larval form, Hydatid systs of *Echinococcus granulosus* (Batsch, 1786) is reported for the first time from the sheep of Delhi State. Hydatid cysts are available from the lung, liver and the subcutaneous tissues of the sheep. A comparative study of the brood capsules, daughter cysts and the Hydatid sand as available from the different tissues of the host, is undertaken. The percentage of the sessile, stalked and immature forms contained in the daughter cysts (together with stalked and sessile buds) is given in a comparative table. It is ascertained that the lung and liver tissues form the most thriving regions in comparison to the sub-cutaneous tissues in the body of the sheep.

116. New superfamily Orchipedioidea (suborder : Echinostomata Szidat, 1939; order : Echinostomida La Rue, 1957).

H. R. MEHRA, Allahabad.

The family Achillurbainiidae Dollfus, 1939 is dropped. It is synonymous to the family Orchipedidae Skrjabin, 1924. The genus *Achillurbainia* Dollfus, 1939 closely resembles *Orchipedum* Braun, 1901 in the absence of prepharynx, presence of short oesophagus and undulating caeca, pre-equatorial acetabulum slightly longer than oral sucker and numerous testes. In *Orchipedum* the latter are entirely post-ovarian and intracaecal but in *Achillurbainia* they are both extra-caecal and intracaecal. Cirrus sac and cirrus are absent and strongly winding vesicula seminalis lies in preacetabular region. Genital pore is median post-bifurcal, ovary is submedian and postacetabular, uterus lies in acetabulo-ovarian zone and eggs are large in both. The vitellaria are composed of numerous small follicles, but they are much more extensive in *Achillurbainia,* where they extend also medianwise interrupted by ovary, shell gland complex, acetabulum and vesicula seminalis. The excretory vesicle is tubular and long. The differences between the genera do not entitle their inclusion in separate families. Orchipedidae contains parasites of bird and mammals and belongs to Orchipedioidea n. supf. Dollfus thinks that *Achillurbainia* shows remote affinity with *Paragonimus* Braun, 1899. Orchipedioidea n. supf. probably stands near Gymnophallid or *Parvatrema* ancestor (Gymnophallidae, Fellodistomatoidea, Fellodistomata) or ancestor of Plagiorchiata as it became evolved from some echinostomid ancestor. Dollfus (1935) traced the development of *Distoma isostoma* (Rud.) into *Orchipedum isostoma* in the nasal fossa of cat *Felis maniculata domest, Mustella vulgaris* and fox *Canis vulpes.*

Diagnosis : Echinostomida; Fellodistomata or Echinostomata, Distomate, unspinate. Acetabulum pre-equatorial, subequal or larger than oral sucker. Prepharynx absent; oesophagus very short or absent; caeca undulating or serpentine terminating near or at end. Genital pore median postbifurcal or preacetabular. Testes divided into numerous follicles. Cirrus sac and cirrus absent. Vesicula seminalis strongly winding, preacetabular. Ovary postacetabular. Receptaculum seminis present. Vitellaria follicular profuse, extending in hind body or greater part of body. Uterus winding, preovarian, intercaecal. Eggs large. Excretory vesicle tubular, long. Cercaria unknown. Metacercaria with Y-shaped excretory vesicle parasitic in Crustacea. Parasitic in birds and mammals. Family Orchipedidae Skrjabin, 1924 syn. Achillurbainiidae Dollfus, 1939.

117. Relationship of suborders Opisthorchiata La Rue, 1957, Reniculata La Rue, 1957, and Plagiorchiata La Rue, 1957 with Echinostomata Szidat, 1939.

H. R. MEHRA, Allahabad.

The position of primary excretory openings of Rhodometopa cercarial embryos of superfamily Renicoloidea (suborder Renicolata) closely resembles that of cercarial embryos of Pleurolophocercous (Opisthorchoid) cercariae. There also exists a basis similarity of the longitudinal membranous fins of the Pleurolophocercous or Ophisthorchoid cercariae to the dorsal and ventral membranous fins of Rhodometopa cercariae. The excretory vesicle is Y-shaped in both these types of cercariae.

The cercariae of *Magapera* (Haploporoidea n. supf.) have also Y-shaped excretory vesicle and develop in rediae. The Echinostomid or Fasciolid cercariae, Pleurolophocercous or Parapleurolophocercous cercariae, Rhodometopa cercariae and of the lage group of Xiphidiocercariae of Plagiorchiata La Rue resemble in having cystogenous gland cells. In all these groups except *Megapera* (Megaperidae) and *Haplosplanchnus* (Haplosplanchnidae) the cercariae possess cephalic (salivary) gland cells. The primitive cercariae of Allocreadiodea Nicoll, 1934 show such close relationship to the Echinostome cercariae that they may be considered to have been evolved from them. The Trichocercous cercariae of *Deropristic inflata* (Cable and Hunninen, 1942) with a long tail possessing a ventral fin fold and six pairs of ventrolateral tubercles each with a delicate hair, posessing eyes, moderately long prepharynx, eight pairs of cephalic gland and cystogenous gland cells is an example of such primitive Xiphidiocercariae, which develop in rediae in marine snails.

The above mentioned resemblances of simple tailed cercariae indicate that they may all be considered to belong to the same order Echinostomida La Rue, 1957 syn. Fasciolatoidea Szidat, 1936. Accordingly the orders Renicolida La Rue, 1957, Plagiorchiida La Rue, 1957 and Opisthorchiida La Rue, 1957 have been dropped.

The preacetabular position of genital opening in the adults of these suborders confirms the above conclusion of their affinity and inclusion in the same order Echinostomida La Rue, 1957. The suborders Fellodistomata and Cyclocoelata also show a similarity in the position of their genital pores. The Trichocercous cercariae of Gymnophallidae (*Parvotrema*) show a basic similarity with those of *Megapera*, *Haplosplanchums* and *Deropristis*.

118. Classification of subclass Digenea Trematoda into orders and of order Echinostomida La Rue, 1957 syn. Fasciolatoidea Zzidat, 1936 into suborders.

H. R. MEHRA, Allahabad.

La Rue (1957) gave a new system of Classification of Digenea. Mehra (1957, 1958) suggested certain modifications. We recognise five orders, Echinostomida La Rue, 1957, Strigeatoidea La Rue, 1926, Azygatoidea Mehra, 1957, Hemiuratoidea Mehra, 1957 and Gorgoderida Mehra, 1958.

1. Order Echinostomida La Rue, 1957 :—Distomate or monostomate with preacetabular genital pore. Cirrus sac typically present but absent in some groups or instead hermaphroditic duct developed with cutaneous copulatory organ cirrus or sucker. Cercariae simple tailed or fork tailed without flame cell groups in tail (Fellodistamata) developing in sporocysts or rediae. Protonephridia monostomate or stenostomate. Miracidia with one pair of flame cells.

2. Order Strigeatoidea La Rue, 1926 :—Distomate or monostomate with genital pore typically postacetabular near or behind the middle body. Cercariae furcocercous, small with flame cell groups in tail developing in sporocysts or rediae. Protonephridia mesostomate or stenostomate. Active penetration into next host. Eggs large. Miracidia with two pairs of flames.

3. Order Azygatoidea Mehra, 1957 :—Distomate or monostomate with acetabulum and without oral suckers. Genital pore preacetabular pre-equatorial near anterior end (*Azygiata* La Rue) or in the middle of anterior margin of tranversely elongated body (*Transversotremata* Mehra). Cirrus sac present or absent. Excretory vesicles Y shaped or V or U shaped. Cercaria furcocystocercous and of gigantic size or monostomate brevifurcate with long furca and tail stem bearing a pair of anteriorly placed arm like appendages arising from basal end of tail and transversely elongated body with pharynx and caeca united posteriorly, developing in rediae. Miracidia with one pair of flame cells.

4. Order Gorgoderida Mehra, 1958 :—Distomate. Genital pore preacetabular near anterior end. Cercariae macrocercous, rhapalocercous or rarely microcercous with simple unforked tail, developing in sporocysts Cirrus sac absent. Protonephidia mesostomate. Miracidia with one pair of flame cells.

5. Order Hemiuratoidea Mehra, 1957 :—Distomate typically. Genital pore near anterior end. Cirrus sac absent. Cercariae highly specialised, cystophorous or hemiurid developing in redae with flame cell groups in tail. Caudal excretory canal present during development. Excretory vesicle cylindrical or saccate; main collecting vessels fused anteriorly. Protonephridia stenostomate. Miracidia nonciliate but with spinose anterior tip developing in rediae. Second intermediate host a copepod. Miracidia with one pair of flame cells.

The order Echinostomida La Rue consists of the suborders :—

1. Echinostomata Szidat, 1939.
2. Fellodistomata Singh, 1960.
3. Paramphistomata Szidat, 1939.
4. Cyclocoealata La Rue, 1957.
5. Opisthorchiata La Rue, 1957, amend. Mehra.
6. Reniculata La Rue, 1957.
7. Plagiorchiata La Rue, 1957.

The suborder Fellodistomata has been excluded from the order Strigeatoidea. It consists of families Gymnophallidae Dellfus, 1939, Fellodistomatidae Nicoll, 1913 and Monothelminthidae Dollfus, 1937 (superfamily Fellodistomatoidea La Rue, 1957).

119. Incidence of Males and Females and seasonal fluctuations of Oesophagostomum columbianum (Curtice, 1890) in sheep.

PREMVATI and S. S. LAL, Lucknow.

A total number of 1330 sheep guts was examined during a period of about three years from October 1958 onwards. Practical investigations have revealed that sixty per cent sheep from the local slaughter house are found to be infected with *O. columbianum* and ten per cent with *O. venulosum*. The proportion of female parasites to male parasites is slightly larger, the ratio ranging between 59 :41 and 52 :48. There is a seasonal fluctuation in the incidence of *O. columbianum.* Maximum average infestations were recorded during the months of March and June or July depending on the early or late monsoons; the peak period being reached only in June or July. Lowest incidence was during the months of April and May. Seasonal variations are correlated with temperature and humidity. Another important factor influencing the outside life of *Oesophagostomum* is that sudden change of temperature is seen to retard the hatching of eggs and development of infective larvae. The month of February shows greatest fluctuation in temperature from 17°C to 28°C. During this month the incidence decreases as compared to cold months of December and January.

120. Comparative morphology of *Hæmonchus contortus* (Rudolphi, 1803) Cobbold, 1898, and *Hœmonchus bispinosus* (Molin 1860) Railliet and Henry, 1909 from sheep and goats with a note on the synonymy of *Hœmonchus placei* (Place, 1893) Ransom, 1911 with *H. bispinosus.*

B. N. SAHAI and P. G. DEO, Izatnagar.

In this paper observations on the comparative morphology of the common stomach worms of sheep and goats, namely *Haemonchus contortus* and *H. bispinosus* have been given in detail. The percentage of infection of *H. contortus* and *H. bispinosus* in sheep and goats was found to be 26·8 and 73·2 respectively. *H. bispinosus* has been recorded from sheep and goats in India for the first time. The females of *H. bispinosus* are differentiated from *H. contortus,* an account of the situation of its vulva anterior to the short and stumpy vulvular process. The spicules in the males of *H. bispinosus* are more than 0·44 mm. in length whereas in *H. contortus* they are less than 0·44 mm. Both the species develop in sheep and goats in 28-38 days from the time of ingestion of the infective larvae.

The synonymy of *H. placci* (Place, 1893) Ranson 1911 with *H. bispinosus* (Molin, 1860) Railliet and Henry, 1909 has been discussed in detail.

121. Studies on the control of Oribatid mites, the intermediate hosts of *Moniezia expansa* (Rudolphi, 1810), Blanchard, 1891.

S. N. SAXENA and P. G. DEO, Izatnagar.

In this paper, the results of the investigations on the efficacy of three acaricides against oribatid mites on pastures are incorporated. The average population of oribatid mites on pastures was found to be highest in the month of August and lowest in the month of January. 40% Nicotine sulphate in the spray solution of 0·2% was found to be 84·4% efficacious against the mites on pastures. 70% D.D.T. in the spray suspension of 0·2% had 88·8% efficacy against the mites, while 25% Lindane in the spray suspension of 0·02% was found to be 92% efficacious against them on pastures. Among the three acaricides tried Lindane was found to be the best in the control of oribatid mites on pasture-land.

122. On a new Trematode from the Redwattled Lapking, *Lobivanellus indicus* (Boddaert).

ATHER H. SIDDIQI and M. SHAMIM JAIRAJPURI, Aligarh.

Four cyclocoeliid trematodes were collected from the air sacs of *Lobivanellus indicus* and were found to be a new species of the genus *Uvitellina*, Witenberg, 1923. The name *U. indica* is proposed. It is 5·683-7·636 long, 1·113-1·536 wide; oral sucker 0·192-0·249 by 0·210-0·326; pharynx subspherical, 0·249-0·345; gonads in an almost one-behind-the-other arrangement, with ovary pretesticular; vitellaria forming a U internal to the cecal arch posteriorly and extending to the level of bifurcation of intestinal ceca anteriorly; eggs numerous, containing ocellate miracidia, 0·136-0·153 by 0·050-0·059.

Skrjabin (1950) recognizes five species of the genus *Uvitellina* and recently Gupta (1958) described a sixth species *U. kaniharensis* from Allahabad. The present species comes closer to *U. pseudocotylea* in body and egg sizes, but differs from it in the topography of the three gonads which form a triangle in the latter species and are almost in linear arrangement in the former. The vitellaria also are internal to the cecal arch in *U. indica* whereas they overlap or are external to cecal arch in *U. pseudocotylea*. It differs from all other species of the genus in having a much smaller body size, extent of the uterus, and topography of the gonads.

(All measurements are in millimeters).

123. Experimental studies on three morphologically indistinguishable species of *Entamoeba*.

WASIM A. SIDDIQUI, Aligarh.

The present study was conducted with the object of discovering: (1) whether *E. histolytica, E. invadens* and *E. moshkovskii* could be adapted to grow at temperatures other than their own optimal temperatures and (2) whether this adaptation is an intrinsic property of the amoebae alone or is influenced by different associates.

DKB, IP and DSR strains of *E. histolytica, E. invadens* and *E. moshkovskii* respectively were used for experiments in a monoxenic condition, with *Clostridium perfringens, C. acidi-urici and Trypanasoma cruzi* as single associates. The experiments were started in each case with an initial inoculum of one million amoebae growing at their respective optimal temperatures. The criteria for changing the temperature were first to observe that at a certain temperature the amoebae could survive and secondly that they could multiply. These two steps were taken to be the maker for adaptation of a certain strain with a specific associate at that particular temperature.

In the present study success has been achieved in adapting DKB strain of *E. histolytica* to grow that 30°C and IP strain of *E. invadens* to 35°C with only *C. perfringens* as a living associate. DSR strain of *E. moshkovskii* could also grow at 37°C very easily but it loses its capacity to encyst at the later temperature. The comparison of normal and temperature-adapted strains of the three species of *Entamoeba* with respect to population cycle showed that at higher temperatures the multiplication rate is higher and the population reaches its peak in 2 to 3 days, while at the lower temperature the multiplication rate tends to decrease and the maximum population is reached by the fourth day.

INSTRUMENTS

124. A Spring balance for continuous record of changes in weight of insects under low pressure.

H. L. KUNDU, Pilani.

The construction of a spring balance which can work under low pressure has been described. The balance essentially consists of a cylindrical glass tube inside which is suspended a coiled spring in the free end of which a small insect carrier is attached. The length of the spring directly varies with the weight of the insect. The glass tube with the spring and the insects can be connected with a low pressure system. The weight of the insect at any time and any pressure or humidity can be read off by measuring the length of the spring accurately with certain optical devices which does not necessitate the touching of the apparatus. The instrument is highly sensitive and accurate. The balance was first constructed by Dr. F. Call of the Zoology Department of Imperial College, London for the author, and later reconstructed at Pilani with Indian technicians.

125. An electronic device to detect certain insect pests.

T. A. DAVIS, Calcutta.

Several species of insect pests of the borer type are often difficult to detect at least in the early stages of their attack. The Red palm weevil (*Rhynchophorus ferrugineus*), one of the major pests of the coconut palm is a good example for this. It is the deadliest of the coconut pests since it kills the tree outright by damaging the cabbage, the only growing point. The pest completes its life cycle within the crown of the palm itself. At a fairly late stage, with the drooping of one or two unopened spear leaves, the pest may be detected, but sadly at this stage recovery in most cases is impossible, although very effective pesticides are available. Thus, every year tens of thousands of coconut palms are killed throughout the coconut regions of Asia and the Far East.

For a timely detection of this dangerous pest, a new electronic instrument has been devised. This instrument which is expected to save several palms from the attack of this weevil is of the size of a miniature hand camera and weighs less than 0·5 kg. It is easy to procure (when manufacturing begins), economical to maintain, handy to operate and worked without causing any injury to the palm.

MORPHOLOGY

126. Kidney disposition in carps.

SURENDER KUMAR AHUJA and MARY CHANDY, Delhi.

The anteriormost part of the mesonephros or the commonly called 'head kidney' in the carp group presents a very interesting disposition. Detailed study of the kidney in *Labeo calbasu, L. gonius, Cirrhina mrigala, Amblypharyngodon mola* and *Rohtee cotio* has revealed that the head kidney consists not only of the lobed structures seen externally but is embedded deep down laterally, so as to have a close association with some parts of the compound vertebra.

Out of all the major carps studied, the head kidney is best developed in *Cirrhina mrigala* where it is even more prominent than the central expanded part of the mesonephros.

Amongst minor carps, *Rohtee cotio* has a well developed head kidney. Its connection with the middle expanded lobe of the mesonephros is peculiar enough to suggest it to be just a reverse condition of what is seen in other carps.

Except for a part of the head kidney that is seen externally in the form of flaps, a large portion of it lies hidden beneath the transverse process of the third compound vertebra in the form of dorsal lobes. Each lobe extends as far as the tripus so as to form a close association with it. The extent of the total coverage of the tripus by the head kidney is variable depending upon its shape and size.

127. On the presence of specialized conducting (connecting) tissue in the heart of the Armadillo.

S. P. BHATNAGAR, Bhopal and O. N. SETH, Vidisha.

The structure and distribution of the specialized conducting tissue of the heart of Armadillo has been studied in serial sections. A well developed kidney shaped sinuatrial node is present in the crista terminalis at the cranial end of the interatrial septum. The sinus venosus is absent. The sinuatrial node is connected with the atrioventricular node through the muscular interatrial septum. A poorly differentiated atrioventricular node is situated in the caudal portion of the interatrial septum. The fibres of A.V. node communicate freely with those of the A.V. bundle and the interatrial septum. The atrioventricular bundle, which is a well developed structure, lies at the cranial extremity of the ventricular septum. It divides into a right and a left branch which extends downwards for a short distance over the respective sides of the ventricular septum. The atrioventricular bundle is connected with the A.V. node by 'Purkinje fibres'. The A.V. bundle is the only connecting tissue between the atria and the ventricles. Multiple muscular connections of Kent are absent. S.A. node, A.V. node and A.V. bundle are all formed of 'Purkinje fibres'. Thus the pathway for the transmission of the cardiac stimulus of contraction is formed of both the ordinary myocardium and the 'Purkinje fibres'.

128. The specialized muscle system and its nervous component in the heart of bats.

S. P. BHATNAGAR, Bhopal.

In the heart of bats the impulse initiating and conducting tissue is formed of sinuatrial node, atrioventricular node, atrioventricular bundle, 'Purkinje fibres', ordinary cardiac muscle fibres and multiple muscular connections of Kent. The heart of bats possess multiple muscular connections of Kent in addition to the bundle of His for a quick transmission of the cardiac stimulus of contraction from atria to ventricles. In this feature the heart of bat resembles that of birds and differs from that of mammals. A continuous muscular pathway exists to convey the cardiac stimulus of contraction from one chamber of the heart to the other. The cardiac impulse initiating and conducting tissue of birds and mammals develops in accordance with the functional requirements of the heart of individual animals. The nervous component of the specialized muscle system as seen in the heart of bat has been described. The nerves and ganglia were observed in the atrial walls and in the vicinity of sinuatrial and atrioventricular nodes. The nerve supply to these nodes has been described.

129. "Bulbus" and "Conus" in the heart of Clupeiformes.

ASIT BARAN DAS, Gorakhpur.

The transition from the selachian muscular, contractile "Conus Arteriosus" to the teleostean non-muscular non-contractile, elastic "Bulbus Arteriosus" is not an abrupt one. Intermediate conditions of the conus, with more than two valves, have been described in Polypteriformes, Acipenseriformes, Amiiformes, Lepidosteiformes and in many lower Teleosts (Clupeiformes). The present account adds to the above list three more fishes from different families of the order Clupeiformes. In *Chirocentrus dorab* (Forsk.) of the family Chirocentridae three conical pocket-shaped valves in a circle have been found in the conus. The same condition in the conus has been observed in *Hilsa ilisha* (Ham.) of the family Clupeidae. In *Notopterus chitala* (Ham.) of the family Notopteridae four ventriculo-bulbular valves have been reckoned, which are arranged in two horizontal tiers, representing two longitudinal rows. However, in *Gudusia chapra* (Ham.) of the family Clupeidae, a typical teleostean condition has been observed in the conus, with only two valves. The shape of the bulbus arteriosus in these fishes ranges from a long tubular type in *Chirocentrus* and *Notopterus* to a short globular type in *Hilsa* and *Gudusia*. The internal surface of the bulbus is trabeculate in *Hilsa* and *Gudusia,* incipiently ridged in *Chirocentrus* and smooth in *Notopterus*.

130. Correlative Histological Changes in the Bursa of Fabricius and the Gonads of the Domestic Pigeon, *Columba livia* Gmelin.

C. J. DOMINIC, Varanasi.

The correlative histological changes in the bursa of Fabricius and the gonads of *Columba livia* have been studied from hatching to sexual maturity. At the time of hatching, when the testes contain only primordial germ cells and spermatogonia, and the ovary only the oogonia, the bursa of Fabricius is already fully developed. The cortex and the medulla of the follicles of the bursa are well defined ; mitosis of the endodermal epithelial cells and of lymphocytes are common. Interfollicular connective tissue of the bursa is thin. At about three months of age, the bursa of Fabricius attains its maximum development. There is a slight increase in the interfollicular connective tissue. When the gonads begin to grow and the bird prepares for breeding, the bursa begins to show signs of involution. It shrinks in size and the lymphocytes in the follicles turn pycnotic and gradually disappear and the remaining epithelial cells reconstitute themselves into epithelial buds. Some of the follicles undergo cystic degeneration simultaneously. When the birds reach the peak of reproductive activity, with bundles of spermatozoa in the seminiferous tubules of the testes and fully grown ova in the ovary, the bursa completes its regression and is represented by a rudiment on the dorsal side of the cloaca, which is composed of connective tissue and a few capillaries. This also disappears after the first breeding season and no trace of the bursa is left behind on the cloaca in adult birds. It is evident that there is a causal relationship between sexual maturity and the bursa of Fabricius in birds. It is suggested that the sex hormones have an antagonistic effect on the bursa of Fabricius. This assumption is further supported by experimental work, where the injection of steroids brings about the premature involution of the bursa in sexually immature birds.

131. The Ovary of the Domestic Pigeon, *Columba livia* with Special Reference to Follicular Atresia.

C. J. DOMINIC, Varanasi.

The ovary of the domestic pigeon, *Columba livia* Gmelin is studied with special references to the atretic follicles. Because of their high frequency of occurrence, the atretic follicles are to be regarded as a normal feature in the ovary of this bird. The follicular atresia shows much variation depending on the stage of growth of the ova and also on the phase of the reproductive cycle. The atretic follicles can be classified into (a) the *bursting* type, (b) the *in situ* type, and (c) *cysts*. The bursting atresia is more common during the progressive, reproductive and regressive phases of the ovarian cycle. Cystic degeneration of the follicles is of very rare occurrence. During bursting atresia, the ovular debris is discharged into the ovarian stroma or into the body cavity after the rupture of the theca. In the *in situ* type, the ovular debris is resorbed *in situ* without the rupture of the thecal wall. The bursting atresia is seen more frequently in the case of the larger follicles, whereas the *in situ* type of atresia is the rule in the younger follicles. The ovular debris is eliminated during atresia by phagocytes which are of granulosa origin. Occasionally stromal cells also act as phagocytes. The theca interna cells do not play any role in phagocytosis. The phagocytes fill the lumen of the atretic follicle by hypertrophy; mitotic or amitotic division is not observed. Pigment formation is not common in the atretic follicles of the pigeon.

The dissolution of the unused ova, after breeding season, is intended for the restitution and rehabilitation of the ovary as well as for lightening the ovary of an unnecessary charge. The occurrence of atresia in the ovaries of nestlings is probably due to a genic imbalance of the oogonia. The significance of the atretic follicles in birds is not properly understood. It is probable that the progestin necessary for inducing ovulation is elaborated in the atretic follicles and thus these structures may be playing some kind of endocrinal role in birds and other oviparous vertebrates.

132. The specialized conducting system of the heart of 31 mm. embryo of *Hemidactylus flaviviridis*.

RAJ KUMAR GAUR, Bhopal.

The heart of 31 mm. embryo of *Hemidactylus flavivirids* has been studied in serial sections and its conducting system has been described. The specialized conducting structures of the heart of this embryo are a sinuatrial node and an atrioventricular plug. A well developed sinuatrial node is present very near to the sinuatrial opening and communicates freely with the sinuatrial valves and the interatrial septum. An atrioventricular node could not be observed. It is pointed out that the development of the conducting system of the heart of Hemidactylus should be completely worked out before denying the presence of atrioventricular node. An atrioventricular plug has been observed to lie just above the atrioventricular opening. It is a narrow U-shaped structure and its two limbs join the base of atrioventricular valves and become continuous with them. The contraction stimulus originating at the sinuatrial node would be conveyed to the atria through the sinuatrial valves and the interatrial septum. This impulse would be transmitted to the atrioventricular plug through ordinary muscle fibres of interatrial septum and would be distributed to the ventricles by the two limbs of the plug after a necessary pause. The phylogeny of the impulse conducting structures of the heart of reptiles, birds and mammals has been discussed.

133. Studies on the Weberian appratus and related structures of Indian Ostariophysi. Part III. The evolutionary significance.

C. L. MAHAJAN and MEENA KUNCHAL, Muzaffarnagar.

The paper records the differences between the lower and higher cyprinids in the structure of the Weberian ossicles. The study shows how these differences might be used to determine the evolutionary status of a given species. It has been found that in general the Weberian apparatus in lower cyprinids shows a lesser degree of fusion between various elements constituting it. Moreover the ossicles forming the chain connecting the air bladder with the internal ear seem to be lighter and less solidly built in lower forms as compared to higher forms. The length of tripus in particular and that of chain in general as compared to total length of fish provides another useful index to determine the place of a given species in the natural classification of the group.

134. Studies on the Weberian apparatus and related structures of Indian Ostariophysi. Part IV. Taxonomic value with reference to the genus *Labeo* (Cuvier).

C. L. MAHAJAN and MEENA KUNCHAL, Muzaffarnagar.

This is a more intensive study of the Weberian apparatus and indicates how a comparative study of this apparatus might be used as an important taxonomic character. Three species of *Labco* (Cuvier) were examined for this purpose and sufficiently distinctive characters were found to differentiate one species from another. These differences are describd in detail and the value of the apparatus as a systematic tool has been emphasized. The importance of such a study, specially to classify rare and fossil fishes can hardly be overestimated in view of the facts presented.

135. On the blood supply of the pecten of cattle egret, *Bubulcus ibis.*

P. N. MEHROTRA, Ranchi.

The pecten of cattle egret is mainly composed of blood vessels and capillaries composed of a single layer of atypical endothelial cells whose cell boundaries are indistinct. The cytoplasm is swollen into a structureless clear homogenous mass in which large and oval nuclei are interspersed. Each of the nuclei contains prominent nucleolus. The main artery supplying the pecten lies near the upper part of the pecten and divides into several branches, each supplying one fold of the pecten. Venules come from each fold of the pecten and join to form a main vein which runs side by side with the main artery.

136. On the structure of the pecten of cattle egret, '*Bubulcus ibis*'.

P. N. MEHROTRA and P. B. SINHA, Ranchi.

The pecten of birds still presents problems which are obscure. The histology of the pecten is best seen in 2-3 μ sections of bleached material. The pecten of the cattle egret is mainly composed of small capillaries composed of a single layer of atypical endothelial cells whose cell boundaries are not distinct. Outside this is a perfectly clear hyaline limiting membrane completely investing each capillary. This membrane does not stain and stands out very sharply as a perfectly clear shining line. The capillaries contain nucleated oval blood cells. In between the capillaries can be seen small cells, occasionally stellate though generally round, each with a round, deeply staining and centrally situated nucleus. The cytoplasm is loaded with pigment granules, a single cell containing 50—100 spherical granules of varying sizes. One or many of these cells may lie between two capillaries. The black colour of the pecten is due to these pigment cells. We have been unable to confirm Franz's observations of sensory hairs and end bulbs in the pecten.

The authors do not agree with the view that the pecten is a portion of the choroid coat which has pâssed through the foetal fissure and proliferated inside the eye. The blood supply of the pecten is connected with the vessels in the optic nerve and not with the choroidal vessel. Further the structure of the pecten is different from the choroid. The choroidal vessels are much larger. Their walls are lined with flattened endothelium and are sometimes more than one cell thick. The cytoplasm lacks the curious swollen appearance of the cytoplasm in the endothelial cells of the pecten. Moreover the capillaries of the choroid lack a hyaline limiting membrane. The pigment granules in the choroid are much smaller but are present in such large numbers that they completely hide the nucleus.

137. On the passage of spermatozoa from the testis tubules.

P. N. MEHROTRA, Ranchi.

The mechanism responsible for the passage of spermatozoa from the seminiferous tubules to the epididymis and onward is not fully understood. Oslund ('28) has suggested that the continuous production of secretion in the seminiferous tubules is sufficient to maintain the current in which the sperms are directed forwards towards the vas deferens. Young ('31) believes that the distally directed current of spermatozoa is maintained in part by the secretion of the seminiferous tubules and in part by the cilia present in the vasa efferentia. Bailey has remarked that the capillary force of the epididymal tubules is one of the factors which direct the passage of sperms.

It was observed that just before the onset of the reproductive season in *Anser anser* and *Copsychus saularis* there is a marked development of connective tissue fibres in the intertubular spaces and around the seminiferous tubules. I, therefore, believe that the contraction of seminiferous tubules brought about by the elastic connective tissue fibres is also an important factor responsible for the movement of sperms in the birds, from their place of production to the vas deferens, in addition to other factors suggested by Oslund, Young and Bailey.

138. Studies on the Urinogenital System of some Marine Teleosts. Part I.

V. B. NADKARNI, Dharwar.

The urinogenital system of eleven species of marine teleosts i.e. *Therapon jarbua, Gerres lucidus, Scatophagus argus, Teuthis oramin, Caranx crumenophthalmus, Equula daura, Sillago sihama, Platycephalus insidiator, Trichiurus* *haumela, Belone strongylurus* and *Chirocentrus dorab* is described. The kidneys are paired, elongated bodies generally fused for a part or whole of their length. In *Belone strongylurus* an isolated head kidney is present on the left side, but, on the right side, the head and the trunk kidney are continuous. An isolated piece of trunk kidney is present in *Scatophagus argus* and *Teuthis oramin* posteriorly. The urinary bladder of *Sillago sihama* passes through the wall of the air bladder which is a unique feature. The urinary pore is independent in all the females studied and also in the males of *Platycephalus insidiator* and *Trichiurus haumela.* There is a common urinogenital pore in the remaining male fishes. Abdominal pores are reported in three female fishes. A slit like integumentary cloaca is found in seven of the eleven species studied.

139. Studies on the Urinogenital System of some Marine Teleosts. Part II.

V. B. NADKARNI, Dharwar.

The urinogenital system of *Rastrelliger kanagurta, Cybium guttatum, Stromateus niger, Pseudorhombus arsius, Synaptura orientalis, Arius platystomus, Chatoessus nasus, Tricanthus strigilifer* and *Tetrodon lunaris* is described. In *Tricanthus strigilifer* and *Tetrodon lunaris* the paired kidneys are short, separate and placed anteriorly in the body cavity. The head kidney in *Arius platystomus* is completely separate from the trunk kidney. The paired mesonephric ducts are generally embedded in the kidney. The urinary bladder is thin walled except in *Cybium guttatum, Arius platystomus* and *Tetrodon lunaris,* where it is thick walled. The urinary pore is independent in all the female species studied and also in the male *Tetrodon lunaris.* There is a common urinogenital pore in the remaining eight male species. The urinary pore in *Pseudorhombus arsius* and *Synaptura orientalis* is placed on the coloured side of the body. Abdominal pores are found in three species, in both the sexes. An integumentary cloaca is reported in five species. In the remaining four species the external openings are placed directly on the body surface.

140. Studies on the pronephros of *Cirrhina marigla* (Hamilton).

V. B. NADKARNI, Dharwar.

The paper deals with the structure and the degeneration of the pronephros in *Cirrhina mrigala*, a major Indian carp. The earliest stage that could be available for the study was the free swimming larva measuring 6 mm. in total length. At 6 mm. stage the pronephros of *C. mrigala* is fully formed. It reaches its functional peak at 10 mm. stage. The stages between 11 mm. to 15 mm. may be regarded as transitional stages when the functional pronephros becomes non-functional. The pronephric corpuscle becomes isolated from the pronephric tubules and the lymphoidal tissue and is progressively reduced in size. It is not absorbed by the pronephric lymphoidal tissue. The degeneration of the pronephric tubules is a slow process when compared to that of the pronephric glomerulus.

141. On the specialized conducting tissue of the heart of *Varanus monitor.*

RAVI PRAKASH and RAJENDRA SAHAI, Betul.

The impulse conducting tissue of the heart of *varanus monitor* has been described. The sinuatrial node has two distinct components. It has been argued that 'U' shaped sinuatrial node of mammals has evolved by the fusion of the two components of the sinuatrial node of reptilian heart. The atrioventricular bundle is present at the posterodorsal margin of the interatrial septum. A connecting muscular pathway has been observed to show that the cardiac stimulus of contraction which would originate at the sinuatrial node would be conveyed to the interatrial septum through the cephalic sinuatrial valve and from the interatrial septum to the atrioventricular bundle and then to both the ventricles. Ordinary muscle fibres as well as Purkinje fibres form the pathway for the conduction of the cardiac stimulus of contraction. The observaitons support the myogenic theory of impulse initiation and conduction.

142. Innervation of the heart of the shrew, *Suncus murinus*.

RAVI PRAKASH and R. C. HARITWAL, Betul.

The nerves that supply the heart and the blood vessels in the shrew, *Suncus murinus* have been examined through dissection of the animals as well as in the serial sections of the heart stained by Peters method. Contrary to the findings of many others the cardiac plexus has been observed to be single and indivisible. Small intrinsic and extrinsic ganglia were also observed. Most of the nerves present in and around the heart run parallel to the main blood vessels. The specialized conducting tissues is also profusely supplied with nerve fibres. The atria are very rich in nerve supply but the ventricles are poorly innervated. The dorsal portion of each ventricle has more nerves than the ventral portion. The present study not only confirms the presence of a specialized muscular conducting tissue in the heart of birds and mammals but it also points out that this muscular conducting tissue is richly innervated.

143. Specialised conducting system in the heart of Indian Gharial, *siGava gangeticus* (Gray).

JAGDISH PRASAD, Beawar.

A complete and adequate conducting system comprising of the structures, Sinuatrial node, atrioventricular node and atrioventricular bundle in the heart of *Gavalis gangeticus* has been observed and described for the first time in Loricata. Histologically specialized structures initiate, control and conduct the cardiac stimulus of contraction. They attribute an impressive bearing on the phylogeney of the impulse conducting tissue of the heart of birds and mammals. *Septum ventriculorium* is unique and contradistinctive. Divergent pathways for the conduction of contraction impulse from sinuatrial node to right atrium exist. One way is through the sinus venosus and the right sinuatrial valve similar to that of Fishes and Amphibians (anaminiata) and the other direct through left sinuatrial valve resembling Birds and Mammals (amniota).

144. Functional development of the accessory respiratory organs in air-breathing fishes in relation to the modification of the swimbladder.

S. Z. QASIM, Aligarh.

Beside performing the function of breathing atmospheric air the accessory respiratory organs like any other gas filled space are also concerned with the perception of hydrostatic pressure. When the air breathing fishes are subjected to change in pressure, the volume of air contained in the accessory respiratory organs is controlled. At increased pressure the gas in the respiratory organs is retained and when the pressure is decreased the gas from these organs is expelled.

In this way the fishes are able to regulate their buoyancy by swallowing and releasing air from the accessory respiratory organs. Such a hydrostatic function of the accessory respiratory organs recalls similarities between these organs and a physostomatous swimbladder, for in this type of swimbladder also the density regulation of the fish occurs in a similar way.

There exists a correlation between the development of the accessory respiratory organs and the modification of the swimbladder. Fishes possessing a well developed physoclistic type of swimbladder such as *Ophicephalus* have primitive pharyngeal type of accessory respiratory organs. But in fishes like *Heteropnuestes* and *Clarias* where the swimbladder has become reduced and non-functional the accessory respiratory organs have become enlarged and highly modified. Presumably the greater development of accessory respiratory organs is an adaptation to compensate for the hydrostatic function of the swimbladder.

145. On the morphology, extrinsic muscles and anatomy of Tongue of garden lizard, *Calotes versicolor.*

R. SAHAI, Raipur.

Morphology, muscles, and minute anatomy of the tongue of garden lizard *Calotes versicolor* has been studied and described. The morphology and anatomy of tongue varies in the apical region, middle and at the root. The extrinsic muscle system is well developed. The position of Geniohyoid, Stylohpoid, Genioglossus and Hyoglossus muscles has been described in relation to the Hyoid apparatus. Mucus glands are sparsely distributed all over the tongue. Lingual glands are paired and posterodorsal in position. Taste buds are absent and only filiform papillae could be located.

146. On the specific differences in the cranial morphology of the two allied species, *Mysius (Osteobagrus) seenghala* (Sykes) and *Mystus (Osteobagrus) nor* (Hamilton).

H. L. SARKAR, Delhi.

An attempt has been made in this paper to find out some dependable osteological characters for differentiating the two allied species, *Mystus* (*Osteobagrus*) *seenghala* (Sykes) and *Mystus* (*Osteobagrus*) *aor* (Hamilton) of the sub-genus *Osteobagrus*. As the cranium of fishes show the stable characters, the adult skulls of the two species, viz., *seenghala* and *aor*, having nearly the same standard length, were taken for the study. After examining the cranium, the most striking points of difference between the two species are tabulated :

	Mystus (*Osteobagrus*) *aor*	*Mystus* (*Osteobagrus*) *seenghala.*
1.	Skull is massive and broad.	Skull is slender and narrow.
2.	Dorsal side of the skull is deeply sculptured and pitted.	Dorsal side of the skull is not prominently sculptured.
3.	Posterior fontanelle is very small and slit like.	Both the fontanelles are prominent and wide.
4.	Supraoccipital process is very strong, long and narrow at the base.	Supraoccipital process is not strong, short and broad at the base.
5.	Space between the antero lateral processes of supraethmoid is small and is one third the distance between the ends.	Space between the antero lateral processes of supraethmoid is wide and is half the distance between the ends.

Mystus (Osteobagrus) aor	*Mystus (Osteobagrus) seenghala*
6. Anterior portion of the supraethmoid projects out considerably after the vomer.	Anterior portion of the supraethmoid projects very slightly after the vomer.
7. Ledge of the parasphenoid is wide, short and extends upto the middle of the frontal ventrally.	Ledge of the parasphenoid is narrow, long and extends to the posterior end of the ectoethmoid ventrally.

On the strength of the analysis of the different osteological characters, it is concluded that *seenghala* and *aor* are two widely separated species.

147. Digestive System of *Scolopendra mersitans* Linn.

G. S. SHUKLA, Gorakhpur.

The alimentary canal is a straight tube extending from the mouth to the anus. The mouth lies on the ventral side of the head. The preoral cavity is bounded by the mouth parts; the hypopharynx divides it into food meatus and salivary meatus. The dorsal part of the food meatus is the cibarium in which opens the mouth. The salivarium lies at the base of the salivary meatus, in which lies the opening of the salivary ducts. The foregut is divisible into the buccal cavity, pharynx, oesophagus, proventriculus and stomodaeal sphincter. The midgut extends from the 14th to the 18th segments. The hindgut opens outside through the anus, and its anterior end has two long slender Malpighian tubules. The salivary glands are paired and mulberry shaped.

The wall of the foregut has a layer of circular muscles on the outside of which are found a few bundles of longitudinal muscles while on the inner side a layer of longitudinal muscles. The epithelium is thin, thrown into folds, and is lined by a thick chitinous intima. In the proventriculus the wall has a thick layer of circular muscles. The midgut does not show chitinous intima while hindgut has a thin layer of chitinous intima.

These animals can feed on various kinds of insects, their larvae, and earthworms but they can take milk and tea and fleshy fruits as well.

148. Presence of Melanoblasts in the testis of some Indian birds.

P. D. TEWARY and R. N. SAXENA, Varanasi.

The presence of dark coloured testis is not uncommon in the birds. During the course of study in certain Indian birds, we found quite a number of them possessing both or one (generally left) testis coloured dark brown or black. This characteristic colouration is due to the presence of melanoblasts in the fibrous connective tissues of the interstitium. A variation in the intensity of the colour (pigment) was also noted which corresponds with the sexual cycle of the animal. During non-breeding season and in juveniles when the testis size is minimum and there is no spermatogenesis, the colour is intense, but as the breeding season approaches, the testis starts increasing then pigmentation decreases and at the peak of the breeding season, when the volume of the testis is maximum, the dark colour has practically vanished. The gonad now appears yellowish white in colour. After the breeding when the testis has become small in size, pigmentation again appears. The reason of this cyclic changes in the pigmentation that follows testis size cycle, may be that, during eclipse the melanoblasts get concentrated in a smaller area of the testis, thus pronouncing their effect, but in the nuptial phase, when the testis enlarges the melanoblastsare dispersed over a larger area resulting in an apparently non-pigmented testis.

It seems, therefore, that this colour variation may be due to changes i
testis volume during the sexual and non-sexual phases resulting in the des
or concentration of the melanoblasts. Percentage of pigmented testes in the
studied is :

Rosy starling (*Pastor roseus*) 14%
Pied mynah (*Sturnopastor contra*) 17%
Bank mynah (*Acridotheres ginginianus*) 13%
Black-headed mynah (*Temenuchus pagedarum*) 13%
Common mynah (*Acridotheres tristic*) 7%
Spotted munia (*Uroloncha punctulata*) 10%
White-throated munia (*Uroloncha malabarica*) 5%
Red headed bunting (*Emberiza brunniceps*) 10%

The role of these pigmented cells inside the gonad is not fully understood

149. The conducting system in the heart of 70 m.m. embryo of redve Bulbul, *Molpastes cafer* (Linn.).

KM. NAJMA YOUSUF, Bhopal.

The conducting system in the hearts of six 70 m.m. embryos of Redve
Bulbul has been studied in serial sections. It is observed that sinus venos
getting incorporated into the right atrium. A well developed sinuatrial nod
present near the cranial end of the interatrial septum and the opening of post
vein into the sinus venosus. The shifting of sinuatrial node away from
sinuatrial opening has been regarded as due to the structure and dispositio
the sinus venosus. The atrioventricular node is a well developed structure situ
near the caudal portion of interatrial septum. 'Purkinje fibres' were not obse
in the wall of atria or in interatrial septum. The two nodes are connected
each other through ordinary myocardium of I.A.S. A well defined saddle sh
atrioventricular bundle was observed at the top of the ventricular septum.
A. V. Bundle bifurcates caudally into a right and a left branch which reach
base of atrioventricular valve of its side. No multiple muscular atrioventric
connections in addition to bundle of His were observed. Several nerves
ganglia were found at the atrioventricular junction and in the nodal regions.

SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY

President :—DR. S. C. SINHA

Abstracts.

I. PREHISTORIC ARCHAEOLOGY

1. Microlithic Industry from North-West Midnapur, West Bengal.

ASOK KUMAR GHOSH, Calcutta.

The paper deals with the microlithic industry of Bhararu, two miles north-east of Silda, north-west Midnapur. This part embraces a portion of the eastern fringe of the Chota Nagpur plateau. The site is located on a high ridge of mica-schist, grey or bluish-grey in colour with bands of gneissose character. The mica-schist is overlain by pisolitic laterite in certain places. The microliths along with cores and waste flakes were found as surface finds on the laterite. It appears that the microliths have come out from pisolitic laterite by erosion and water action. The materials used for the microliths are white quartz, black quartz with white stringers and cherty quartzite which locally occur in the form of veins in the hard quartzites in the neighbourhood.

The site yielded a good number of microliths and associated cores and waste flakes. The microliths include blades, scrapers, points, awls and pseudo-burins. The industry appears to be very primitive as evidence from the crudity of technique and absence of evolved types. Typologically it recalls the microlithic industries of adjacent districts of Singbhum and Manbhum.

2. Stone Age vestiges in and around Badami (Mysore).

K. V. SOUNDARA RAJAN, Baroda.

The paper summaries the obseravtions of the author on the collection of Early Palaeolithic and Late Palaeolithic tools he had made in the vicinity of Badami in the autum of 1960. The context of the Early Palaeolithic tools on quartzite picked from Badami town and its environs, to some extent compares, broadly speaking, with the similar but more typical tools observed in the detrital lateritic coastal high ground north of Madras around the Red Hills area.

The rest of the collections of medium to small size tools picked up from the neighbourhood of Sitalphadi cave in the uppermost rocky terrace, on the other hand, shares many comparable features with Late Palaeolithic tools elsewhere but show evolution over the typical Middle Stone Age Industries and, at the same time, only anticipate but not participate in the truly microlithic *mileau*. A few specimens and types of this collection are indeed of the microlithic and perhaps show the overlap of the later development. The collection could well be called 'proto-microlithic'.

The nature of the cave remains and the artefact remains indicates fruitful possibilities if further detailed work is undertaken in the region.

3. Microlithic industries from Adamgarh rock shelters near Hoshangabad, Madhya Pradesh.

R. V. JOSHI and M. D. KHARE, Nagpur.

The occurrence of microliths near the Adamgarh rock shelters is known since long. In the last winter the authors carried out excavations in the rock-shelters and in the open ground adjacent to them. Nearly 18 trenches were taken each one of which yielded a large number of microliths. The associated deposit was black clay or silty clay which was either resting directly on the local quartzite rock or lying with a marked erosional disconformity over the red lateritic clay. No soil profile was seen anywhere on the top of this hill.

The microlith-bearing deposit seems to have been derived from the adjoining black cotton soil plain (terrace) of the Narmada by wind action.

The tools assemblage consists of crescents, various points, blades, and scrapers, a few burins all made on chalcedony and allied siliceous material. The raw material seem to have been brought from the neighbouring Narmada river bed. The occurrence of huge quantity of raw material, cores and unfinished tools in association with the finished implements suggests that this was a factory site.

The microliths were found in all the levels of the black deposit and it appears that the formation of this deposit was contemporaneous with the microlithic settlements of the Adamgarh hill.

4. Excavations at the Palaeolithic site on the Adamgarh hill near Hoshangabad, Madhya Pradesh.

R. V. JOSHI and M. D. KHARE, Nagpur.

In 1935, de Terra collected a few palaeoliths from the laterite pockets on the Adamgarh hill in the vicinity of the rock-shelters. They comprised of Abbevillian-like handaxes and pebble choppers with no Acheulian artefact. In the subsequent explorations at this site several artefact wre obtained from the surface deposits.

With a view to find the definite source of these tools and to know the characters of the implementiferous deposit the excavations were carried out in the rock-shelters as well as in the adjacent level surface on the Adamgarh hill. A large trench approximately in the centre of this hill yielded nearly 150 implements. These were recovered from the rubble bed which was mixed up with the red laterite clay. Underlying this tool-bearing horizon was the hard gravely laterite resting on the rock.

The majority of the tools were stained red due to associated lateritic clay. The collection comprised of handaxes, cleavers, choppers, cores, flakes and flake scrapers with a dominant Acheulian characters. On the north-east slope of this hill a naturally exposed section showed highly weathered quartzite rock overlain by ferruginous (lateritic) hard crust. On it were resting in successive order laterite, disintegrated laterite (pisolitic laterite gravel) red clay and the stone rubble. The stages of lateritization of the quartzite and sandstone of this hill could very well be noticed here.

This implimentiferous clay deposit is comparable to the red concretionary silty clay of the Lower Group of the Narmada Pleistocene deposits.

5. On the Occurrence of Quartzite-flakes in the Neolithic deposits at Nagarjunakonda.

H. SARKAR, Guntur.

In the excavation at Nagarjunakonda a large number of flakes and blade-like flakes of quartzite were found in the neolithic levels in association with neoliths of dolerite, microliths of chert and prismatic quartz-crystal, besides pottery, beads of shell, paste and steatite and other miscellaneous stone objects like pestle etc. In the majority of cases, these flakes are not secondarily worked into any standard tools, nor do they seem to be waste material of neolithic tool manufacture, as no neolith on quartzite was obtained in the Nagarjunakonda valley. In addition to these quartzite flakes, others of dolerite were also discovered, but since all the neolithic tools are of dolerite, the existence of dolerite flakes can be understood.

These quartzite flakes, in all likelihood, were utilized by the neolithic settlers of Nagarjunakonda in their daily requirements, which normally could not have been met with by neolithic tools proper or by microliths.

6. Megalithic Human Remains excavated at Yelleswaram (Andhra Pradesh).

PABITRA GUPTA and PRATAP CHANDRA DUTTA, Calcutta.

Through the courtesy of the Director of State Archaeology Department, Hyderabad, during April, 1961, the writers had the privilege of examining the megalithic human skeletons excavated at Yelleswaram which is situated on the left bank of river Krishna, opposite to the ancient site of Nagarjunakonda.

Five crania, of which three are males and two females, and a few long bones were studied. Only two crania are better preserved and are in somewhat complete form. The skulls are massive, rugged and the bones are thick. Of the three male skulls one is hyperbrachycranic and two are brachycranic, while among the females one is mesocranic. The skulls are euencephalic in cranial capacity. Applying Dupertuis and Hadden's as well as Pearson's formulae stature is estimated to be tall.

In a recent publication Dr. S. S. Sarkar has reported the presence of similar brachycranial and mesocranial skulls from the megaliths of Brahmagiri, Mysore. He postulates that these brachycephals were foreign in origin and he traces affinity with the Sialk megalith builders. This hypothesis may further be confirmed on publication of report on Nagarjunakonda megalithic skeletons.

II. PHYSICAL ANTHROPOLOGY

7. Human Crania from the Historical Site at Ujjain.

PABITRA GUPTA, ARABINDA BASU and ANIMA RAY, Calcutta.

At the historical site of Ujjain human crania were unearthed during May, 1939 from a high mound at Kumhar Tekri. In this paper report on 18 better preserved skulls have been presented, of which 12 are male and the rest are female.

The crania are dolichocranial, orthocranic, euryprosopic and chamaerrhine. Morphologically, foreheads are slightly arched with moderate parietal eminence, moderately projecting occiput with moderate mid-facial width and medium to broad nasal aperture.

It is a point of interest that sexual dimorphism is reflected only in dimensions and not in proportions.

The series is not very divergent and in conformity with the existing population of Northern India. In the typyal sense Ujjain crania agree fairly well with the Punjabi and Rajput skulls.

8. Preliminary Study on the Hair Characters of the Australian Aborigines (Western Australia).

A. R. BANERJEE, Calcutta.

A study of 48 hair samples (male—17; female—31) from the Australian aborigines from western Australia were undertaken for the following: form, colour, texture, hair length, medullation, and hair diameter. It has been found that in males flat, broad, and narrow wavy hair occurs in equal frequqencies, while in females, broad wavy hair occurs in the highest frequency. The incidence of medullated hair is higher in both the sexes (male—68·47%; female—52·64%) than the non-medullated type (male—31·53%; female—47·36%). Among the Australoid tribes of India the medullated hair has been found in the frequency of 68·08% and 74·59% in males and females reespectively. The male hair is thicker ($97{\cdot}63 \pm 0{\cdot}83\mu$) in diameter than the female ($82{\cdot}37 \pm 0{\cdot}61\mu$). The hair diameter of the male Australoids has been found to be $97{\cdot}04 \pm 0{\cdot}94\mu$ while that of the female $89{\cdot}28 \pm 1{\cdot}33\mu$.

9. Ethnic affinities of Rajputs of Pauri Garhwal (U.P.).

R. K. GULATI, Poona.

Somatometric measurements and somatoscopic observations were taken on 86 male Rajputs called Khasiyas of Pauri Garhwal (formerly British Garhwal) in 1956. The Garhwali Rajputs are a heterogeneous group as indicated by different somatometric and somatoscopic characters. Even the great range of variation in majority of the characters supports this.

The Garhwali Rajputs are akin to rest of the Cis-Himalayan people e.g. Brahmins, Rajputs and Artisan of Jaunsar, Kanets of Kulu; Brahmins, Rajputs and Doms of Almora etc. with respect to stature, cephalic index and nasal index. But with respect to stature and nasal index they seem to be akin to the preponderantly Mongoloid human group of Nepal and Eastern Himalayas and Bhotiyas of Almora on the one hand while the high castes of Almora, Baghel Rajputs (U.P.) and Gwala of Bihar on the other hand. However, the predominant element among these people is medium stature and dolicho heads, in association with lepto to mesorrhine nose. The Brachycephalic heads are present in 3·48% of the cases. The Somatoscopic characters like skin colour, hair form, eye colour, and other such characters indicate that Garhwali Rajputs are a mixed group. The 'test of significance' also shows the closest possible similarity with Doms, Kasa Rajputs of Almora and Rajis of Almora. The value of co-efficient of variation is above 4 for 25 out of 32 characters which clearly show that they are highly mixed.

10. The Anthropometry of the Lambadi Males.

PABITRA GUPTA and ARABINDA BASU, Calcutta.

The Lambadi, a seminomadic tribe of Southern and Western India, trace their origin from the Rajput. Anthropometric data were collected during January—April, 1960 from two districts of Andhra. They speak a corrupt form of Hindusthani and Marwari. Historical records and linguistic evidences point their origin from Northern India particularly Rajputana.

In physical appearance, they are medium to below medium in stature, mesocephalic and hypsicephalic in head, mesorrhine in nose, and mesoprosop and euryprosop in face. They are relatively fair complexioned.

Comparison has been instituted with different Rajput groups and it is observed that in many characters they agree with the Rajput while in others they differ.

These divergences might be due to mixture with other populations and segregation from the original people from whom they trace their origin.

11. Bengal Kayasthas and Nagar Brahmans of Gujarat—A study of the surnames and physical characters.

BIKASH CH. RAYCHOUDHURI, Calcutta.

In this paper an attempt has been made to estimate the limitation of proving racial identity based on similarities of surnames of the Nagar Brahmins of Gujarat and Kayasthas of Bengal. The paper has been divided into four sections. In section I the analysis of the earlier authors has been done with some suggestions; section II deals with the history of the Nagar Brahmans who figure prominently in the hypothesis advanced by Bhandrakar and Chanda; Section III deals with the comparative study of stature, head length, head breadth, nasal height, nasal breadth, cephalic index and nasal index of the Nagar Brahmans, Bengali Kayasthas, Vangaja Kayaysthas, Dakshin Rarhi Kayasthas, Baidyas and Dakshinatya Vadik Brahmans of Bengal amongst whom the similarities of some of the surnames are noticed. The value of 't' has also been calculated which proves in conclusive so far as Nagar Brahmins and Bengal Kayasthas are concerned regarding their racial identity. But with the Dakshinatya Vadik Brahmans and Vaidyas of Bengal does not seem to have any racial connection; section IV gives the summary of the discussion.

12. Dermatoglyphics of the Plantar Digitis—its relation to the finger prints.

DEBA PRASAD MUKHERJEE, Calcutta.

Toe and Sole prints were collected from both the sexes of thirteen tribes of Manipur, Nagaland and Assam during a dermatoglyphic survey. The toe prints of 116 male individuals have been discussed in this paper.

Whorls in toes range from 10% to 38% and Fibular Loops from 35% to 87%. Tibial Loops are up to 10% and Arches up to 55%. An inverse relationship is observed between the occurrence of patterns in Toes and Fingers. This is less marked among the Garo and Khasi.

The bipedal and bimanual distribution are in the reverse direction. Whorls are more common in left toes and Arches in right. High frequency of Whorls occurs on III toes, and also in II and IV. The Fibular Loops and Arches are most frequent on V and I toes, and Tibial Loops always on I. The digital distributions may have resulted from a more medial axis of the foot than that of the hand.

13. Tribal migration to Urban Industrial areas—its effects on health and nutrition of the tribals.

AMAL KUMAR DAS, Calcutta.

The role of the proximate principles of food in maintaining proper standard of health and nutrition has been discussed and the need for a balanced diet stressed.

People leading healthy lives for generations in a region can develop capacity for adjustments to local conditions for maintaining proper nutritional level.

In a diet study of an Oraon village near Lohardaga (Ranchi) in 1955, the daily Calori intake of a standard unit amounted to 2527, and the people were observed to be healthy and well-built.

Overpopulaton in a limited area and need for cash money for paying off debt urged some tribals to migrate to urban industrial areas. But in spite of increas in cash earning there, their general health gradually deteriorated. Food wa pretty costly and of doubtful purity in industrial area and air breathed was vitiate with dust and smoke. Many became addicted to heavy drinking and some contracted venereal diseases and some even tuberculosis.

Industrial employers should therefore take sufficient care to protect triba recruits from these sources of deterioration of health to minimise absentee-ism.

14. Widow Remarriage and Fertility.

MANINDRA KUMAR NAG, Calcutta.

The present analysis is based on the reproductive histories of 2689 ever-marrie women of seven villages in West Bengal. The frequency of remarriage of widows is higher among the Muslims than among the Hindus in general, but there ar exceptions. Among the Hindu Muchi, 44% of the widows are found to have bee remarried, and among the Muslim Sheikh only 5% of the widows are found to have been remarried. The loss of reproductive period per ever-married woman due t post-widowhood celibacy is 1·5 years for the Hindus and 1·0 year for the Muslims, but the fertility level of the Hindus is higher than that of the Muslims. The inter- and intra-group variations in fertility among the Hindus and Muslims cannot b explained by their variations either in the frequency of remarriage of widows o in the loss of reproductive period due to post-widowhood celibacy. Two reasons why the loss of reproductive period per ever-married woman due to post-widowhood celibacy is not as high as expected in the groups for which the frequency o remarriage is comparatively low are that (i) the average age at widowhood is comparatively high among them, and (ii) the proportion of women widowed is comparatively low among them. The latter two variables seem to be important in relation to fertility.

15. Demographic Effect of Firuz Tughlakh's raid into Orissa (1381 A.D.).

JATINDRA MOHAN DATTA, Calcutta.

Firuz Tughlak raided Orissa in 1361 A.D. Besides those killed in war, from about 5 to 6·5 lakhs were destroyed in cold blood. The estimated population about that date is about 30 lakhs. From about *one-sixth* to *one-fifth* of Orissa's population was killed. It is based on two contemporary official sources : (1) *the Sirat-i-Firuz-Shahi* ; and (2) Ainul-Mulk's *Insha-i-Mahru*, supplemented by Afif's *Tarikh-i Firuz-Shahi*, which have been followed by Dr. R. C. Majumdar in his DELH SULTANATE.

16. Demographic Data from the Bible.

JATINDRA MOHAN DATTA, Calcutta.

Taking the data as given in the A.V. of the Bible to be correct, the rate of growth of the Israelites has been from Joseph's time to the Exodus, a period o 430 years 21·5% per decade, during the 40 years of sojourn in the Sinai peninsula 0·9% per decade; and from their entry into Canaan to David's time, a period o 270 years, 3·33% per decade (71).

Plague and pestilence destroyed about 4% of population in 1320 B.C. and in David's time 4·5%—6·4%. During their sojourn in the Sinai peninsula, the population was of Regressive Type.

Much depends upon the correct Biblical chronology, about which scholars differ.

III. SOCIAL AND CULTURAL ANTHROPOLOGY

17. Comparative Study of the Kinship Systems of two Polyandrous Communities.

BHABANANDA MUKHERJEE, Calcutta.

1. Polyandry among the Jaunsari and the Toda has not developed the same patterns in their terminological and kinship systems. Cross-cousin marriage has basically aligned the relatives among the Toda into the traditional pattern of the South Indian kinship system. Equivalence of siblings and unity of sibling group are consistent with Jaunsari joint family structure in a fraternal polyandrous situation, whereas the situation is paradoxical among Toda who practise nonfraternal polyandry and cross-cousin marriage.

2. Fundamental differences between the two systems are noticed in the parents' and ego's generations which clearly bear out that they do not conform to any type. This is also supported by the differential applications of kinship criteria.

18. The Maler Social System : levels of Unity and extension.

L. P. VIDYARTHI, Ranchi.

The paper, methodological in nature, describes the net-work of relationship of a Maler as a member of the Paharia Community, as a member of the Maler tribe and then as a member of the "region of contacts" and above all as a member of his village and his lineage. It has been brought out that the unity of the Maler on the tribal level is to be noted only in their consciousness to be a Maler. The real unity among the Maler on an extra-village level is observed in terms of "region of contacts". A set of villages falling within a radius of ten miles are in mutual interaction with each other. Such regional contacts (extension of a village according to Opler) are observed in a Maler village owing to (i) Marriage, (ii) exchange of labour among relatives, (iii) visits on the occasion of festivals, (iv) showing of common weekly market, (v) and the regional *Sardari* system. The above analysis indicates that the interaction of a Maler village with the world outside is relatively less extensive than a Plain-dwelling Santhal or a Hindu village.

With these extensions, a Maler village is essentially a self-contained unit, which is marked with the following characteristics : (i) Sense of belongingness to a village, (ii) Idealisation for the village, (iii) relationships among the families of the village through the lineage and corporate groups, (iv) sharing of the same sacred places and sacred specialists by all the villagers, (v) the village panchayat, (vi) The village youth dormitory, (vi) and then a set of informal contacts and companionships.

19. Magico-religious ceremonies connected with the economic activities of the Lodhas.

P. K. BHOWMICK, Calcutta.

The Lodhas of Midnapur, are a denotified tribe of West Bengal. Declared criminals, they suffered a lot of harassment, till the revocation of the Criminal Tribes Act in 1951.

Even so, they are a festive people, cheerful, both in body and mind. Besides their own festivals, they have assimilated a few others from the annual cycle of the neighbouring Hindus, along with the presiding gods and goddesses, and worship them. A few such festivals, connected with their economic activities and agricultural in nature, have been described in this paper. These are popularly known as—(1) Jathel, (2) Ashari, (3) Muchri, (4) Ceremony of the 'Nal' or reeds, (5) Worship of Bani, (6) Worship of Lakshmi and (7) Worship of Sar, and each is, more or less, connected with their agricultural and economic life.

But a sharp trend of assimilation of Hinduistic culture is discernable in these festivals, although, these have been tinged with tribal variations, here and there. It is an indication of the advancement of this tribe from the pool of backwardness. On the other hand they are also maintaining their own cultural distinctiveness.

20. Social Mobility Movement Among the Mahato of South Manbhum.

BIMAN KUMAR DAS GUPTA, Calcutta.

This paper deals with the trends of caste mobility movements among the Mahato of South Manbhum. Before the 1920's, they took part in group-dancing, practised widow-remarriage and took country liquor and fowl. During that period, they were not so conscious about their assumed relation with the Kurmis of the other parts of Bihar, U. P. & M. P. as also with the Kunbis of Maharashtra. Now-a-days, as a result of a series of caste meetings held in different areas of Manbhum, there has been a tendency of considering themselves as belonging to the same cultural stalk as that of the Kurmis of other parts of India. Concocted fictions tracing descent from Chhatrapati Shivaji, are there. Sacred thread is being worn. Group-dancing, wine, fowl and widow-remarriage have been forbidden. Use of veil has been introduced for married women. Recently, secular aspirations for economic and educational advancement have overshadowed their earlier exclusive concern with ritual purification.

21. Culture Zones of Rajasthan, Preliminary findings and a critique of methods.

P. K. MISRA, Nagpur.

The major portion of Rajasthan with two main Geographic regions namely one to the north-west of the Aravalli Hills and the other to the south-east, was during the British period under a number of Indian princes.

The north-western portion of Rajasthan forms the major part of the great Thar desert. The south-eastern portion comparatively has more of rains and is green.

Broadly, Rajasthani is the language of the whole of Rajasthan but it contains several dialects each of which demarcates a contiguous area. Rajasthani itself is bounded by Broj Bhasa and Bundeli in the east, with Bundeli, Marathi, Bhili, Khandesi and Gujarati in the south. On its west it has Sindhi and Lahnda and on its north Lahnda and Punjabi—all these surrouding dialects and languages including Rajasthani belong to the Indo-Aryan family.

The people of Rajasthan represent an interesting mosaic of caste groups, each having a distinct set of rules and behaviour.

The present paper is primarily concerned with a preliminary mapping out of the distributional zones of a few selected traits of material culture and delineating the nature of their possible interrelatedness. This paper also examines how far these trait areas are coterminous with Geographical regions and dialect areas and also how these are related to similar items of culture beyond the frontiers of Rajasthan.

A study of this nature raises a number of fundamental problems of theoretical interest regarding classification of cultural forms, and also in the matter of diffusion of traits.

22. The Institution of Panji.

BAIDYANATH SARASWATI, Nagpur.

The system of keeping genealogical records among the Maithil Brahmans, concentrated in Mithila (North Bihar), was first introduced in 1326 A.D., and is still a living institution. The system is called Panji; the persons who record the genealogies are Panjikars.

The Maithil Panji not only records the genealogies of the families but also regulates the marriage system and determines the position of the individual in group hierarchy as affected by marriage alliances. The Panjikars hold their offices in village Saurath where every year, on auspicious days (Sudhas) thousands of people assemble to negotiate marriages. It is necessary for every person to get a certificate of non-relationship (Aswajana-patra) between the two contracting parties from these Panjikars.

The institution of Panji stimulated hierarchical notions in the regional social structure and encouraged hypergamous and polygynous marriages. Matrimony became a profession and Kulinism flourished. Under the impact of modern developments, the bridegroom's consideration has shifted from a kulin to a holder of University degrees, but the institution of Maithil Panji remains unaffected, for the solidarity of the Maithil society lies with this institution.

23. Industrialisation—Its effect on Economic and Socio-psychological life of tribals.

AMAL KUMAR DAS, Calcutta.

The scope of industrialisation and its recent rapid growth in India have been discussed.

The influences of this rapid industrialisation on the economic, social, psychological and moral aspects of the tribal peoples' lives have been examined.

Tribal migration to industrial areas and displacement of tribals due to installation of large industrial undertakings have been discussed and needful for their rehabilitation in areas similar to their traditional set up stressed.

The ill effects of living in industrial area have been discussed particularly, the upsetting of the family, interpersonal and social relationships, replacing their traditional community and family mindedness by self-centred attitude, and also disintegration of taboos and clan baviers, moral laxity, increased drinking habits and consequent physical deterioration and diseases.

Contacts with peoples of different ethnic groups have widened their sphere of knowledge, removed superstitious and broadened the mind and understanding. Political consciousness has started awakenning, but owing to their illiteracy, they are falling pray to trade unionisms and designing political groups who exploit them.

In spite of their eagerness to take to industry, they are yet psychologically inapt for machinery handling.

"Human Engineering", the new branch of Technology has therefore to be popularised here as in other advanced countries for co-ordination between industry and human reaction.

24. Christianity in a Tribal Village.

K. MAHAPATRA, Bhubaneswar.

The paper is based on data from a Kandha village in Phulbani district of Orissa. It is a comparative study of the degree of cultural differentiation between the Christian and Non-Christian Sections of the tribe. The analysis of the data leads to the conclusion, that although the two sections of the population are distinguishable, both in terms of some selected cultural traits and as social groups—the pattern of interaction between them is co-operative.

25. Tribal life in Gujarat.

P. G. SHAH, Bombay.

The system adopted by the Gujarat Research Society for the study of the tribes of Gujarat covers besides cultural life, socio-economic conditions, a study of health and nutrition, physical measurements which includes important data such as anthropometric measurements, serological and intelligence testing so as to give a complete picture of tribal life in all its aspects social, material, physical and cultural.

Gujarat is a cultural, social, linguistic unit which has also acquired an independent political status since May 1960. The tribal life in this region has many unusual features. Like other people of Gujarat the tribes form a special group by themselves although spread over large areas. Out of 1,61,49,036 total population of Gujarat the tribal population forms 12·78 per cent of the total (20,64,522).

As the tribes are living in Gujarat for a long period the general culture of the people of Gujarat and the regional factors have influenced them very much and have produced a strong impact on their life. Yet the tribes have continued to maintain many tribal characteristics which set them apart as a group.

The main tribes of Gujarat are Bhils (8,47,879), Dublas (1,74,369), Naikas (1,28,604), Gamits (1,11,901), Dhankas (32,514), Kukanas (figures not available) Chodhras (figures not available) Dhodias (figures not available). The first four tribes form one group whereas the last four another. The first group is more backward than the second group as seen from their educational level, social customs, social level, superstitions, religion, economic level, aesthetic sense, food habits, observance of festivals etc.

Yet each tribe has something distinct by way of culture and so we find that physically, serologically, sub-group among one tribe differs from sub-group among other tribe *e.g.*, Tadvi-Bhils and Tadvi-Dhankas.

Thus the tribal life in Gujarat partakes many cultural peculiarities of the region with which are interwoven many general and special characteristics of tribal life which lend each tribe a peculiar character.

26. Cultural affiliation of Orissa on the basis of certain important material traits.

N. K. BEHURA, Calcutta.

Politically and linguistically Orissa consists of an area of 60,250 square miles consisting a population of 14,645,946 as per 1951 Census. It presents countless castes of the Hindu social order as well as a number of Dravidian and Mundari speaking tribes.

Analysing of a selected groups of material traits it has been observed that Orissa is an important meeting ground of the two major cultural traditions of India namely, Dravidian and Indo-Aryan.

Within the state itself, there are significant variations in material traits in the four broad regions namely Northern, Eastern, Western, and Southern. While some of these variations relate to ecological differences in these regions, the entire area is inhabited by people speaking a single dominant language namely, Oriya.

27. The Namputiris of Kerala.

K. V. KRISHNA AYYAR, Coimbatore.

The Brahmins of Kerala now consist of the Namputiris, Emprantiris, Ayyars and Pattars, and Konkanis. The Namputiris differ from the others in their mother tongue—which is Malayalam—restriction of the marriage to the eldest son, post-puberty marriage, polygamy, and impartibility of the family property.

The Konkanis came to Kerala to escape the religious persecution of the Portuguese; the Ayyars and Pattars after the conquest of Tinnevelly or Southern Pandya by the rulers of Travancore in the fourteenth century; the Emprantiris in consequence of the adoption, off and on, of the Kolattiri or Chirakkal princesses by the Travancore rulers. Nothing definite is known about the coming of the Namputiris.

As the other three divisions retain their separate mother-tongue even after their settlement in Kerala, and as Malayalam, the mother-tongue of the Namputiris is spoken only in Kerala, the ancestors of the Namputiris must have settled in Kerala before the common Dravida language spoken east and west of the Ghats branched off into Malayalam and Tamil. This process began with the Chola invasions inaugurated by Rajaraja I in 988, the invasions blocking the hitherto uninterrupted communication between the west coast and the east coast.

The arrival of the Brahmins in Kerala was not in the nature of a mass movement; it was a slow infiltration as in other parts of South India.

Namputiri with its contracted form *Nampuri* is a compound formed by the two words *Nampi* priest, learned man or saint, and *Sri* (written as *Tiri* in Dravida) august or auspicious. And just as *Svami Sri,* august chief or lord, became *Samutiri* and *Samuri* (Zamorin of Calicut) *Nampi Sri* became *Namputiri* and *Nampuri.* Chaplain Visscher of the early seventeenth century was the first western writer to refer to the Kerala Brahmins as *Namputiri* and *Nampuri,* though the thirteenth Chinese historian Chau Ju Kua calls Kerala by the name of the *Nanpi* country. The earliest inscription to recognise the Kerala Brahmins as a separate class belongs to 1229.

As early as the Samgham age the Brahmins had established their hold upon the people as priests and learned men.

By taking an active part in resisting the prolonged Chola aggression, they were also able to carve out little principalities of their own.

By entering into free unions with the women of the matrilineal but warlike Nayars, who were their comrades in arms, they established a personal hold on them by the bonds of affection and filial respect.

The free unions made the Namputiris averse to sacramental marriage within the caste. And the eldest son alone came to marry within the caste. As marriage below the caste was unthinkable, the marriage of the Namputiri girls had to be postponed, virgin marriage gave place to post puberty marriage. As only the eldest son married, polygamy also came into vogue. And as the younger sons remained in theory bachelors, the family property could not be divided.

28. Pronouns of Address in a Few Indian Languages.

MANINDRA KUMAR NAG, Calcutta.

The paper deals with the association of the pronouns of address with two dimensions of social life, namely, power and solidarity, in Bengali, Hindi, Urdu and Gujerati. It indicates the semantic and stylistic variations of the pronouns of address in these languages and seeks to find out the correlation, if any, between semantic change and social change.

Compared to the contemporary European languages, all the four Indian languages are found to have more non-reciprocal power-semantics. A study of the differential changes in pronominal address during the last two or three generations reveals that the solidarity semantic has been gaining supremacy over power semantic in all the four Indian languages, as in European languages, but there have been more changes in Bengali than in the other three. The changes in Bengali show the same trend as in European languages, that is, towards the dominance of the mutual use of the pronominal form of condescension and intimacy among the members of a family and among friends. The apparent trend of change in the other three Indian languages towards the mutual use of the pronominal form of reverence and formality is in contrast with the European trend. Attempt has been made to explain the difference.

29. A short general background of Assam and Khasi and Jaintia Hills.

PRANAB KUMAR DAS GUPTA, Shillong.

Assam was the country known as *Pragjyotisha,* in the days of the epics and as *Kamrupa,* in medieval times and has been mentioned both in the *Ramayana* and *Mahabharata.*

This paper deals in brief with the mythological, racial, and historical background of Assam and Khasi & Jaintia Hills.

30. The Influence of Sources of Information in the Propagation of Certain Family Planning Methods.

PRAFULLA C. BEBARTA, Bombay.

In this paper an attempt is made to explore the influence of information sources in the propagation of certain family planning methods. The sample comprises of 666 women of Greater Bombay who were married at the time of the Survey. Out of them 48·3 per cent were ignorant of any family planning methods, 51·7 per cent were aware of one or other methods, and 17·3 per cent had ever used any methods.

The findings reveal that the most influential sources in imparting knowledge on methods were friends, neighbours and acquaintances. The physicians were most influential in the use of methods. And the husbands were the most effective source in converting knowledge into use.

Female sterilization was comparatively more propogated through medical sources, and other methods through informal interpersonal sources. The women who adopted sterilization or diaphragm, pessary and jelly, a larger percentage of them knew from medical sources. About other methods they knew from interpersonal sources. Medical sources were influential in converting the knowledge on many methods into use.

Many more studies are needed on this line and other related lines in testing hypotheses, in building up theories and also in making models for action research.

31. Hand-made Pottery in Madhya Pradesh and the Distribution of the Handmade Pottery in India.

SUHAS KUMAR BISWAS, Calcutta.

The first part of the paper has been devoted to describe in detail the process of manufacturing the handmade pottery in three villages of the Madhya Pradesh.

The hand-made potter caste, known as the KUMHAR, is sub-divided into a number of endogamous groups. The hand-made potters are regarded by the upper castes as lower in status than those who turn out pottery on the wheel.

In the second part, the hand-made pottery manufacturing techniques of different regions of India, including the Andaman and the Nicobar Islands have been compared. This is based on the tempering materials added to the primary clay for making different types of pots, the shaping and the firing processes.

The existence of hand-made pottery in the north-east India is more widespread than its occurrence in the rest of India. It is likely that the north-east and the South Indian hand-made pottery industry is South East Asian in origin.

SECTION OF MEDICAL AND VETERINARY SCIENCES

President :—DR. J. C. BANERJEA, M.B. (Cal.), M.R.C.P. (Lond.), M.R.C.S. (Eng.)

Abstracts

MEDICAL SCIENCES

1. Histochemical Changes in the Endometrium of Rabbit Induced by Oral Administration of Indigenous Contraceptive Drugs.

H. S. CHAKRAVARTI, Calcutta.

While searching for a contraceptive drug effective by oral route, the author came across a formula in Ayurvedic Medicine (Bhava-Prakasha), consisting of *Embelia ribes* (N. O. Myrinicae), Piper *longum* (N. O. Piparacae), borax and asafaetida. This preparation is to be taken by the female partner immediately after menstruation for a few days and has been emphatically reported to be effective in preventing conception.

In order to find out its mode of action, if any, experiments were carried out in immature female rabbits in two groups. In one group (control) only oestrogen was injected 50 I.V., I.M. alternate days for 3 days and in another group (experimental) in addition to oestrogen injections, above oral contraceptive drug was given daily. Animals were sacrificed on the 6th day and, cornu of the uterus was examined for any histochemical change.

Result showed that the intense alkaline phosphatase reaction in endometrium produced by administration of oestrogen, was very much inhibited by simultaneous administration of this drug by mouth. Also in the experimental group there were marked reduction of the polysaccharide structure (glycogen) and nucleic acid substance (DNA & RNA) in the cell of the endomectrium as compared with the control group. It seems probable that such inhibition of the cellular activity of the endometrium by administration of the drug may be effective in preventing conception. Further work in this line is in progress.

2. Neurogenic influence on absorption of sugar in the Rat Inestine.

R. N. SEN, Sambalpur.

Rate of intestinal absorption of three sugar compounds (d-glucose, d-mannose and d-fructose) was studied against concentration gradient with and without vagal stimulation in vitro methods. Special feature of this vitro preparation was eversion of the intestine, so that mucosal surfaces of tied sacs were directly exposed to oxygenated medium. The technique of Wilson & Wiseman was followed.

The results so far obtained suggest that vagal stimulation enhances the rate of absorption of d-glucose across the wall of small intestine of rats. Vagal stimulation also increases the rate of absorption of d-mannose and d-fructose to a minor extent. These two compounds however are not actively transported across the wall of rat intestine.

3. A comparative Study of the Diuretic effect of the Extractives from Fresh and Dried Plants "Kuliakhara" *(Asteracantha longifolia* Nees).

P. K. SANYAL and P. N. VARMA, Calcutta.

From the previous work of Sanyal and Bhattacharya it has been observed that the plant "Kuliakhara" as a whole has a good diuretic effect on rats. The drug is always used fresh, when available, by the Ayurvedic Physicians. It was, therefore, thought that the extractives obtained from fresh plants be compared with extractives of dried plants collected 6 months before the experiment.

Maximum diuretic effect was observed with 50 per cent alcoholic extract of the dry plant which contained no alkaloidal bodies according to investigations done previously. It was of the order of 3·4 times urine volume increase while its corresponding extract from fresh plant which gave positive tests for alkaloids gave 1·9 times urine volume increase. It seems that alkaloidal bodies of the plant have little to do with its diuretic effect.

As far as water extracts are concerned the decoction of fresh plant gave slightly better result as compared to the decoction of the dried plant.. Water extracts of fresh plant are even better in diuretic effect than the 50 per cent alcoholic extract of fresh plants, giving positive test of alkaloidal bodies. This further goes to support the view that alkaloidal bodies have either no or very little role in the diuretic activity of the plant. The better activity of the fresh plants may be due to more of extractables sugars, polysaccharides and the inorganic salts.

There seems to be a close relation between the inorganic content of the extractive and diuretic property but they are not well marked and not applicable to all cases. In spite of this, from the correlating figures so far obtained, the inorganic content of the extractive has an important role.

95 per cent alcoholic extract of fresh plants gave no better results than those obtained from 50 per cent alcoholic extract. Average increase in urine output compared to control was 1·8 times.

4. *Asteracantha longifolia* Nees--its diuretic effects on rats.

P. K. SANYAL and S. K. BHATTACHARYA, Calcutta.

The drug Kuliakhara *Asteracantha longifolia,* Nees, known in Hindi Materia Medica as colling, diuretic and stimulating, has been tested for its diuretic effects on groups of male rats. The plant as a whole and its different parts like flower leaves, stem and root were extracted by water, 50% alcohol and 100% alcohol (100%—w/v.). It has been shown that :

1. The drug possesses very reliable diuretic action in doses 4 c.c./100 gm. which goes up to about 300% above saline or water control.
2. Roots have negligible while flowers have moderate action.
3. Leaves, stem and the whole plant possess high diuretic action.
4. Alcoholic extract 50% possesses more diuretic action than watery extract even if it is measured against alcoholc control.
5. Alcoholic extract 100% does not show any advantage over 50% alcoholic extract.
6. The drug is singularly free from toxic action, even if it is administered for months at a stretch, and in this respect it is preferable to mercurials and the recent synthetic drugs like Diamox or Chlorothiazide.
7. Much higher doses have been administered orally and it has not been possible even with very high dose to produce any toxic effect whatsoever by any of the doses which could be administered by a syringe and stomach tube. On the other hand the animal seems to gain in weight and agility.

5. Preliminary Study on the Haematinic Properties of *"Kuliakhara"* *(Asteracantha longifolia,* Nees).

P. K. SANYAL and P. N. VARMA, Calcutta.

While treating number of patients for Œdema, Ascites and Anasarca, it was observed that with extract of *Kuliakhara*—the Haemoglobin content of all the patients improved considerably. The Iron content of the Extract of *Kuliakhara* was determined by Mercuric Nitrate—Ammonium thiocyanate method. The percentage of Iron content in the ash was found to be 22·54 per cent.

A number of male and female patients in three batches were given extract of Asteracantha (Water Extract) under hospitalised conditions. The first two batches consisting of three males and three females were given Asteracantha preparations by mouth and another (second) two batches consisting of three males and three females were given the same. Asteracantha preparation along with some reputable Iron preparation of the trade. A third batch was treated mainly with diets without any Iron or Asteracantha preparations. The treatment was carried out for five weeks for all the above cases. It was observed that the first two batches had remarkable changes in Haemoglobin, the second two batches had practically identical changes to first two batches while the third batch (standard) showed practically no improvement.

It was established, therefore, that Asteracantha preparations had a remarkable Haematinic effect which may be due to the Iron content of the drug.

6. Studies on the Germination of Bacterial Spores-Effect of Incubation of *Bacillus Megatherium* Spores in Peptone and Glucose solutions.

V. SUBBA RAO and D. VISWESWARAM, Waltair.

The effect of prolonged incubation of *B. megatherium* spores at 37°C in peptone and glucose solutions was studied. Nearly 95% of the initial number of spores were found to lose their heat resistance within 3 hours when incubated in 1) 1% peptone solution and 2) 1% peptone and 1% glucose mixture. After 3 hours the solutions turned turbid indicating that the organisms were growing and multiplying. Heat resistance tests performed after 24 hours of incubation indicated that the vegetative cells were again forming into spores. The spore counts were determined daily till 7 days and the results were plotted against time of incubation. The spore counts were found to increase in both the solutions but in the case of peptone solution, the increase was more rapid than in the case of peptone-glucose mixture.

From this work, it is found that peptone solution favours germination as well as sporulation of *B. megatherium.* Glucose appears to have a definite inhibitory effect on the sporulation of the organism, though it does not appear to have any effect on the germination of these spores. It is proposed to study further the different conditions that favour these changes.

7. The effect of gastric secretory stimulant on Sodium and Potassium contents of Gastric Juice and their relationship with its acidity and pH in human subjects.

M. L. PAI, Baroda.

Twenty-four healthy adult male medical students were chosen as subjects after their fractional gastric analysis examination with alcohol as test meal was found to be normal. Ninety gastric samples were analysed for free and total acidity, pH, sodium and potassium contents, the latter two by the method of flame photometric analysis, using "EEL" flame photometer. The free acidity ranged from 11·5 to 122·0 mEq/L with a mean of 34·6 ± 2·18. The pH varied from 1·32 to 6·45 with a mean of 2·16 ± 0·12. The potassium content ranged from 4·9 to 42·3 mEq/L with a mean of 17·1 ± 0·52. The sodium content varied from 16·9 to 84·3 mEq/L with a mean of 44·6 ± 2·98. A reciprocal relationship was found to be present between the acidity of the gastric juice on one hand and its sodium and potassium contents on the other. This relationship was found to be statistically significant. The correlation between acidity and sodium was 0·43, that between pH and potassium was 0·21 and the one between acidity and pH was 0·38, all the above three values being found to be statistically significant. The significance of the above findings has been discussed in the paper.

8. Modifications in the synthesis of Progesterone from Diosgenin.

V. M. BAKSHI and Y. K. HAMIED, Bombay.

Modifications were used and conditions standardised for the synthesis of Progesterone from Diosgenin. Extraction of 4% Sulphuric acid hydrolysed Dioscorea Deltoid roots with carbon tetrachloride yielded spectroscopically pure Diosgenin. This was converted to pseudodiosgenin acetate which was then oxidised with Chromic acid to Δ^{16} pregnenolone acetate. Low pressure hydrogenation in ethanol using Raney nickel as catalyst selectively reduced the Δ^{16} double bond of Δ^{16} pregnenolone acetate and then deacetylation with 2% methanolic sodium hydroxide gave pregnenolone. Oppenauer oxidation of pregnenolone with acetone and aluminium tert.-butoxide as catalyst yielded progesterone in an over all 40% yield from Diosgenin. The purity of intermediate compounds was checked by their melting points and infrared spectra.

9. Preliminary Results of a Survey of the Charasteristics of a Normal Indian Adult.

K. VENKATARAMAN and S. SOMASUNDARAM, Trombay.

Standards for protection from ionizing radiation are recommended by the International Commission on Radiological Protection ICRP. Maximum permissible concentrations of radio isotopes in air and water (food) and the maximum permissible body burden of radio-isotopes are recommended by the sub-committee II on permissible dose for internal exposure. These values are based on the characteristics of a standard man, which are typical of an average Western adult. Preliminary studies carried out by the Health Physics Division, Atomic Energy Establishment, Trombay indicated that the characteristics of a normal Indian adult may differ significantly from those of the ICRP standard man so as to warrant modification of the radiation protection standards in the light of Indian conditions. In order to examine this problem more thoroughly, the Division has started work on the establishment of the characteristics of the normal Indian adult. Data on total body weight and weights of individual body organs have been collected from the post mortem records of a few hospitals in Maharashtra, Tamil Nad and Utter Pradesh states. These data have been statistically analysed and evaluated for any significant differences between these regions.

10. Pharmacology of Petroleum Ether.

BIDHU B. ROY, Calcutta.

Petroleum ether given intratracheally to anaesthetised cats produced abrupt fall of blood pressure, slowing of heart rate and arrest of respiration, the hypotension appearing earlier, and sustaining longer, than either the bradycardia or the apnoea. Bilateral cervical vagotomy could prevent the last two effects but atropine could prevent only the bradycardia. Neither procedure had any significant effect on the hypotension, which also remained unaffected by prior administration of antihistaminics. Acetylcholine, in presence of atropine, produced the usual vasopressor response during the period of maximum hypotension induced by petroleum ether; the degree and duration of the hypotension was, however, considerably curtailed by prior administration of hexamethonium.

The mechanism involved is discussed and attention is drawn to the close similarity between the triple response produced by petroleum ether and some of the veratrum ester alkaloids.

11. Role of Plasma Cholesterol in Angina of Effort.

D. P. BASU and K. B. BAKSHI, Calcutta.

(a) 20 patients were studied in this group. The total cholesterol mean was 234·7 mg.%; Free cholesterol mean was 61·4; F/T × 100 was 26.

(b) These patients showed a much greater tendency to hypercholesterolaemia; of the 20 patients 19 showed plasma cholesterol greater than normal mean.

(c) Free cholesterol concentration in the plasma showed a similar general and indeed proportional increase above the normal mean, the value of F/T × 100 remaining unchanged.

(d) The age effect found in acute myocardial infarction did not exist in this group of patients.

(e) The tendency to hypercholesterolaemia is roughly related to the time elapsed since the first attack of pain.

12. Localization of Cholera Bacteriophages after Intravenous Injections.

S. MUKERJEE, Calcutta.

A group IV cholera bacteriophage filtrate was administered intravenously in a series of rabbits. They were sacrificed at planned intervals from 15 minutes to 72 hours and localization of phage in different organs were tested by plating homogenisates of the organs with a sensitive strain of *V. cholerae* and counting the plaques formed after 24 hours. Viable phage particles could be isolated within 15 minutes of the injection from all the organs tested namely, heart's blood, spleen, liver, kidney, bladder, intestinal walls, bile and contents of the small intestine. Phage concentrations gradually fell with time but viable phage could still be isolated from all organs after 48 hours.

We have reported observations that the gut-inflammatory reaction caused by *V. cholerae* in the tied loop of intestine of a rabbit could be prevented by injecting bacteriophages. Intravenously administered phages are likely to reach the site of infection early and in sufficient concentration to exert their effects on the disease process.

Recently a Russian team of scientists working in East Pakistan reported satisfactory results in treating cholera cases by bacteriophages. The present findings lend support to the rationale of their application of intravenous phage therapy as supplement to the usual oral administration of bacteriophages.

13. Study of the Dynamics of Central and Peripheral Pressure Pulses in cases of Coarctation of the Aorta (preoperative and two postoperative cases).

H. K. BOSE, Calcutta.

(1) Sixteen cases of coarctation of the aorta were studied, where central and peripheral pulse tracings were obtained by indirect method. In 11 cases, coarctation also involved atypical sites.

(2) 5 cases were male and 8 were female. Among the male cases three had in the atypical site, of which two had in the abdominal aorta and the others had the coarctation in the left carotid and in the left subclavian as well. Among the female cases, four had in the abdominal aorta, three in the left carotid as well as in the left subclavian arteries. In the remaining one, the right innominate artery was only involved but without affecting the aorta.

(3) Similar studies were carried out on sixteen normal subjects of the same age group.

(4) Normally the Femoral pulse precedes the Brachial by an average of about 0·02 sec.

(5) The transmission and the build-up time of the pressure pulses distal to coarctation are increased than the brachial of the same patient. The upstroke is small, delayed with broad, low, rounded peak, often plateau-like or has a characteristic saw-tooth contour appearing as an almost smooth, flat curve indicating no landmark of the beginning of diastole.

(6) After operation (in two cases) definite improvements in the pulse wave characteristics were noted.

(7)The haemodynamic factors involved in the genesis of such pulse wave propagation have been discussed.

14. Preliminary studies on Stephania hernandifolia as an Ecbolic drug and its role in contraception in mice.

N. K. ROY and A. N. BOSE, Calcutta.

Stephania hernandifolia (Beng. Aknadi, Sans. Patha) is widely used in Ayurvedic and other system of medicine (Roxburgh) particularly in Sylhet. If applied on os uterus it expedites Labour (Biswas). From a sister species *S. glabra* one alkaloid has been isolated having antimicrobial activity (Roy Choudhury and Siddiqui). In Japan a good number of alkaloids have been isolated from *S. japanica* (Chopra) one cepharanthene having antitubercular activity. Work with *Stephania hernandifolia* (Aknadi of Bengal) carried out in our laboratory reveals that alkaloids isolated from the roots, rhizomes and leaves though having spasmolytic effect on the intestinal movement of rat and guineapig, do not affect the uterine tissue of these animals in rest or active state. The maximum action noticed is some increase in tone and tendency to regularize irregular spasmodic movement. Fresh leaf extract however while exerting inhibitory effect on the intestinal movement shows definite spasmodic effect on the uterine tissue in activity in rats and guinea pigs. It has however been observed that fresh leaf extract orally administered in mice during mating time appreciably prevents conception. The animals in a very high percentage of cases fail to conceive till the drug is discontinued. The effect of the drug however continues for, one, some time two estrous cycles. Further work for determining the proper time during the estrous cycle for administration of the drug and systemic changes responsible for the action is being continued.

15. Clinical evaluation of a new oral synthetic hypoglycaemic agent.

A. N. BOSE, Calcutta.

Detailed pharmacological work on a number of synthetic biguanide compounds carried out in this laboratory, showed that the compound termed AD_3, (N'-α-phenylethyl-biguanide hydrochloride) exerts a powerful and sustained hypoglycaemic activity in animals, while possessing a low toxicity and satisfactory tolerance even or prolonged administration. In consideration of these findings, the drug was put to clinical trial on cases of diabetes in the different wards. Ten cases, all indoor patient and adults of diabetes were studied. After a thorough physical and biochemical examinations, the patients were put under a stock diet of 2000 calories, for an observation period of one week. If the blood sugar was not controlled, the patient was put on AD_3 the dose being gradually increased from 50 mg. to 100 mg. three times a day, given before meals. Urine was checked daily for sugar and acetone bodies. Blood sugar was estimated every week. The total period of drug intake varied from case to case, the minimum being 10 days and maximum 3 months.

The clinical trials show that AD_3 exerts a satisfactory control of the diabetic state, the blood sugar is gradually controlled with slight increase in weight and a healthy appearance. In no case acetonuria was detected during therapy, and there was no complaint of nausea, vomiting or headache or diarrhoea even on prolonged administration. It is concluded that the drug AD_3 (a new biguanide) possesses satisfactory therapeutic possibility and can be safely used on large number of cases for the control of adult diabetes.

16. Haemagglutination and the complement fixation test in Leprosy. A comparative study.

A. N. ROY, Calcutta.

In an earlier report it has been observed that the CF reaction of leprosy sera tested with antigen made of bacillary emulsion of Myco-bacteria leprae gives specific and sensitive reaction and that this antigen does not show any cross reaction with sera of tuberculosis cases. Haemagglutination reaction of sera of leprosy cases tested by Middlebrook-Dubo's test method has been reported to give high percentage of positive result. But the haemagglutination test is considered as non-specific.

In the context of these two reports a study was undertaken to compare the CF and Haemagglutination tests reaction of sera of clinically diagnosed leprosy cases. Present paper shows the result of this comparative study of sera of lepromatous and tuberenloid type of leprosy cases examined by two antigens—one specific and the other non-specific.

17. Some clinical observations and necessary conclusions in the Chemotherapy of Pulmonary Tuberculosis.

SHIBDAS BHATTACHARYA and NARAYAN CH. BHATTACHARYA,
Rajpur.

Of all previously trumpeted Antitubercular drugs streptomycin, Isoniazide and Paraamino-salicylic-acid only are used presently. Proper evaluation of their merits and demerits is necessary.

Tuberculosis has tendency for self-limitation. Hence to avoid false conclusions effective drug must clinically improve 70 to 90% of all cases within one month.

With streptomycin—90% of all cases clinically improve in 15 to 30 days. Usually severe cases require surgical interferences, in addition, for cure. Prolonged use for $1\frac{1}{2}$ years to 2 years with increasing intervals between two injections is necessary for preventing relapses. Usual total dose is 120 to 200 gm. Relapse cases also improve as in original case.. No drug resistance is noted. Some cases improve partially only. Improvement with Prednisolone is noted here. Rarely streptomycin may flare up disease. Four case records are cited. Mild streptomycin-sensitiveness develops after prolonged administration in some cases. Few are streptomycin sensitive from beginning. Streptomycin acts better and quicker than I.N.H. or P.A.S. Case records are cited. Combined P.P. or A.P. and streptomycin treatment gives better and quicker result than either alone.

With Isoniazide no marked clinical improvement in short period occurs, so also with P.A.S. Present antitubercular drug of choice is streptomycin.

18. The Antiveratrinic action of fifteen local Anaesthetics.

V. N. SHARMA, Jaipur.

The antiveratrinic activity of fifteen local anaesthetics are reported against veratrine response induced in frog's sartorious muscle by veratridine 1 :10 million. 1-RBO-12-A C-10, U-0045, U-1804, U-2397, U-0069, P-267 and U-0172 possess strong antiveratrinic property. Next in order of potency are U-0575, U-0177, U-2363, U-0290 and P-169. McN-A-67-11 and Lignocaine are less effective than quinidine. The role of potassium responsible for veratrinic action of veratridine and suppression of efflux of this ion by local anaesthetics has also been studied.

19. Study of three Alpha-aminoethyl Esters of substituted Benzoic Acid on Cardiac, Skeletal and Smooth Muscles.

F. S. K. BARAR and V. N. SHARMA, Jaipur.

Three alpha-aminoethyl esters of substituted benzoic acid closely resembling procaine hydrochloride structurally have been studied for their actions on the cardiac, skeletal and smooth muscles.

All the three agents exhibited a negative inotropic and chronotropic effect on the amphibian and mammalian hearts. They also caused a reduction in the coronary flow, as determined in the perfused rabbit heart. McN-A-0286-11 showed maximum depressant activity on amphibian myocardium while McN-A-285-11 had maximum depressant activity on mammalian myocardium. This differential action could be explained by a species difference.

The antiacetylcholine activity has been worked out on the skeletal and smooth muscles. McN-A-240-11 exhibited maximum skeletal muscle relaxing activity, McN-A-285-11 had maximum spasmolytic activity on the guinea-pig ileum and McN-A-286-11 had maximum activity as a bronchodilator and on the isolated rat uterus.

The results have been discussed in the light of available literature.

20. Suppression of Acute Ventricular Tachycardia in dogs by Three Benzoic Acid Derivatives.

V. N. SHARMA and K. P. SINGH, Jaipur.

Three benzoic acid derivatives viz., B-Diethylaminoethyl 2 :3 :5 :6 tetramethyl benzoate (McN-29-11), Tridiurecaine (McN-100) and 2-Methyltrimethylene diurecaine dioxalate (McN-120-41) have been studied for their suppression effect on ectopic ventricular tachycardia following two stage coronary ligation in dogs.

B-Diethylaminoethyl 2 :3 :5 :6 tetramethyl benzoate (McN-A-29-11) was found to be significantly potent in restoring normal sinus rhythm in all the tests.

All the compounds had bradycardiac effect on the total heart rate which was, however, short lived.

21. Antiacetylcholine, Antiaccelerator and local Anaesthetic activity of some Quinidine like drugs.

V. N. SHARMA, Jaipur.

Fifteen new compounds, seven of which are derivatives of benzoic acid were studied for their antiacetylcholine, decelerator and local anaesthetic activities. The antagonistic action to acetylcholine was studied on frog rectus abdominis muscle. The antiaccelerator activity was determined in the heart lung preparation in dogs. The local anaesthetic activity was investigated on guinea--pig cornea for surcace anaesthetic effect, the intradermal injection method was employed for infiltration anaesthesia and frog's lumbar plexus for conduction anaesthesia. Local tissue irritancy was found by the rabbit eye test, trypan blue test in rabbits and rabbit ear test.

The correlation between local anaesthetic and antiarrhythmic actions is rather a close one (rank correlation coefficient r=0·73). A similar but less marked parallelism existed between antiacetylcholine and antiarrhythmic properties (r=0·69). Next is the correlation between antiacetylcholine and local anaesthetic action (r=0·53). The parallelism between antiaccelerator and antiarrhythmic (r=0·41); antiaccelerator and local anaesthetic (r=0·35) and between antiacetylcholine and antiaccelerator activities (r=0·13) was, however, not significant.

Three compounds viz U-0290, 1-RBO-12-A and U-2397 exhibited strong potency and low toxicity and hence warrant clinical trials in tachycardia as well as for their local anaesthetic activityy.

22. Vitamin A metabolism in Cirrhosis Liver.

M. L. GUPTA and R. L. AJMERA, Jaipur.

Metabolism of Vitamin A in 14 patients of cirrhosis of liver was studied. Vitamin A and carotenoids were estimated colorimetrically at 610 mu. (Carr-Price method) and 445 mu. respectively in blood before and 5 and 24 hrs. after administration of a test dose of 3 lac. I.U. of Vitamin A (Glaxo) orally. Similarly Vitamin A and carotenoids were estimated in urine of 24 hrs. before and after the test dose.

The resting plasma levels of Vitamin A and carotenoids were 26·3±2·1 (16·8–47) and 41·5±3·3 (22·5–60) ug. % respectively. The low plasma level of Vitamin A may probably be due to exhaustion of hepatic reserves of Vitamin A and excretion in urine. The low carotene level may be due to anorexia, and defective absorption due to bile salt deficiency. The 24 hours urinary excretion of Vitamin A was 24·9±7·7 ug. which may be due to associated renal glomerular damage. Carotenoids were not excreted by any patient.

After the test dose the plasma level of Vitamin A rose to 98·1±5·2 ug. in 5 hours and came down to 45·1±3·5 ug. in 24 hours, while plasma carotenoid level did not show any significant change. This flattened tolerance to Vitamin A, low rise after 5 hours and high level after 24 hours as compared to the resting level is possibly due to defective absorption from the intestines, excretion in the urine and reduced storing capacity of liver.

The 24 hours urinary excretion of Vitamin A (33·0±7·9 ug.) after the test dose was not significantly higher than the resting excretion. Carotenoids were not excreted in urine.

23. Vitamin A metabolism in Nephrotic Syndrome.

M. L. GUPTA and R. L. AJMERA, Jaipur.

Metabolism of Vitamin A was studied in 8 patients of nephrotic syndrome, Vitamin A and carotenoids were estimated colorimetrically at 610 mu. (Carr-Price Method) and 445 mu. respectively in blood before and 5 and 24 hours after administration of an oral test dose of 3 lac. I.U. of Vitamin A (Glaxo). Similarly Vitamin A and carotenoids were also estimated in urine of 24 hours before and after the test dose.

The resting plasma levels of Vitamin A and carotenoids were 79±8·8 (41·4 118·8) and 92·3±11·5 (41·2–141·5) ug. % respectively. The significantly higher concentration of Vitamin A in plasma may possibly be due to reduced storing capacity of liver and or kidney. The carotenoids concentration was within normal limits. The 24 hours urinary excretion of Vitamin A was 66·5±17·2 ug. which may be due to the glomerular affection. Carotenoids were not excreted by any patient.

After the test dose the plasma levels of Vitamin A rose to 202·2±18 ug. % in 5 hours and came down to 116±12·6 ug. % in 24 hours while plasma carotenoid level did not show any significant change from the resting levels. The high levels of Vitamin A after 5 and 24 hours may be due to (i) high resting levels and (ii) disturbed storage mechanism of kidney and possibly of liver also. The 24 hours urinary excretion of Vitamin A after the test dose was 119·5±29·2 ug. which was not significantly different from the resting excretion statistically. Carotenoids were not excreted in urine.

24. Vitamin A metabolism in Ch. Suppurative conditions of Lung.

M. L. GUPTA and R. L. AJMERA, Jaipur.

Metabolism of Vitamin A was studied in 7 patients of Ch. suppurative conditions of lung. Vitamin A and carotenoids were estimated colorimetrically at 610 mu. (Carr-Price method) and 445 mu. respectively in blood before and 5 and 24 hours after administration of an oral test dose of 3 lac. I.U. of Vitamin A (Glaxo). Similarly Vitamin A and carotenoids were also estimated in urine of 24 hours before and after the test dose.

The resting plasma levels of Vitamin A and carotenoids were 48·1±2·4 (40·9–52·1) and 85·1±9·2 (48–112·5) ug. % respectively. Both the levels were within normal limits, though the carotenoid levels in these cases were higher than in the normal subjects. Only one patient excreted 28·2 ug. Vitamin A in 24 hours urine. Carotenoids were not excreted by an patients.

The low resting plasma level of Vitamin A has been reported by many workers in acute inflammatory conditions of lung, which is possibly due to an associated renal glomerular damage causing excretion of Vitamin A in urine. The normal Vitamin A level in Ch. Suppurative pulmonary conditions is possibly due to absence of any renal damage or if it is initially present, it has recovered either completely or partially as only one patient out of the 7 excreted Vitamin A in urine.

After the test dose the plasma levels of Vitamin A rose to 143·6±9·2 ug. % in 5 hours and came down to 55·6±2·4 ug. in 24 hours. These levels were not significantly different from the normal subjects indicating the normal removal and storage capacity of liver and other tissues and normal intestinal absorption. The carotenoid levels did not show any significant change from the resting levels. After the test dose 3 out of 7 subjects excreted Vitamin A 4·2—50 ug.) in 4 hours urine indicating a partial recoverly of renal glomerular damage in these subjects.

VETERINARY SCIENCES

25. The diagnosis of Cysticercosis in goats and sheep by Haemagglutination test.

G. BISWAL, S. N. PANDA and D. B. MISRA, Cuttack.

The incidence of cysticercosis in domestic ruminants is high in this country and elsewhere, but there is no reliable method of diagnosis during life.

Sera from 81 goats and 67 sheep were tested with Boyden's tannic acid Haemagglutination Test in order to ascertain the usefulness of this test in the diagnosis of *Cysticercus tenuicollis* infection in these animals. Unconcentrated cyst fluid was used as the antigen. In 90 goats and sheep with cysticercosis, 77 (85·5%) showed haemagglutination titres of 1 : 80 and more while 53 (91·4%) out of 58 negative animals reacted only at 1 : 10 dilution of their sera. Boarderline serum titres of 1 :20 and 1 : 40 were observed in 14·4% positive and 8·6% negative animals. For diagnostic purpose, a title of 1 : 80 and above might be regarded as positive. The precipitation test was found to be of little value for the diagnosis of cysticercosis. The importance of using sensetive serological tests in the diagnosis of cysticercosis in animals has been discussed and the extent of limitation, under certain circumstances, has been pointed out.

To the knowledge of the authors this is perhaps the first report recorded in the literature for the diagnosis of cysticercosis in goats and sheep by Haemagglutination Test.

26. An investigation into the incidence of Brucellosis in fowls.

J. DAS, S. N. PANDA. N. K. DUTTA and B. N. ACHARYA, Bhubaneswar.

Brucellosis is known to occur in cattle, sheep and goats of India, but there is no information about its incidence in fowls. The possibility of *Brucella* infection in poultry was investigated in 150 birds by testing their sera for the presence of the agglutinins against *Br. abortus*. On the basis of agglutination and agglutinin absorption tests, it was found that 12 (8%) birds had serum titres enabling them to be classified as "positive reactors". Specificity of the serological reaction was studied by heat treatment of the serum samples of positive reactors. Some of the *Brucella* positive unheated serum samples cross-agglutinated with *Sal. puliorum* antigen. Further work is in progress. The significance of these observations in relation to the epidemiology of Brucellosis in fowls has been duscussed.

27. Histopathology of Bovine Arteriosclerosis due to Onchocerca armillata.

G. BISWAL, B. C. NAYAK and S. C. MOHAPATRA, Cuttack.

Records on sclerotic lesions due to the parasite *Onchocerca armillate* are very few and during the course of routine post-mortem examinations the authors recorded six cases of this condition in two bulls, three bullocks and one heifer. Aortic lesions associated with dilatation and hypertrophy of left ventricle, vulvular lesions, hydropericardium, hydroperitoneum, focal fibrinous pericardititis, catarrhal and catarrho-haemorrhagic enteritis were encountered at necropsy.

Macroscopically diffuse conspicuous lesions in the thoracic aorta characterised by plaques with depressed centres, raised up yellowish to greyish streaks, and innumerable minute nodules resulting in large nodular elevations due to their fusion, were present. The lesions in the abdominal aorta were discrete. The vasavasorum were involved in all the specimens and adult parasites were visible under the intima.

Sections of the lesions stained with Haematoxylin and Eosin, Verhoeff's and Vonkossa's method revealed intimal furrows containing parasites around which infiltration with mononuclear cells, macrophages and foam-cells were seen. Elastic degeneration accompanied by connective tissue proliferation was associated with varying degrees of calcification in the intima, and in the surrounding tissue of the parasites in media.

The Pathogenesis of atherosclerosis caused by *O. armillate* as distinct from other causes has been discussed.

28. Studies on host-specificity of Haemonchus Spp. in sheep, goats, cattle and buffaloes.

B. N. SAHAI and P. G. DEO, Izatnagar.

Investigations on the host-specificity of sheep and goat strains of Haemonchus spp. namely *contortus* and *H. bispinosus* in sheep, goats, cattle and buffaloes are reported in this paper. Experiments with goat strains of *Haemonchus. spp.* indicated that cattle were partly refractory to this infection, the percentage of development of worms being $1_3$6. In sheep and goats, however, the infection of this strain was found to be 8·75 per cent and 13 per cent respectively, mostly nearing the normal infection of these two species encountered under natural condition.

With the sheep strain of *Haemonchus spp.* similar results were obtained; cattle were found to develop only one per cent of infection of this strain while goats and sheep were found to develop 9·5 per cent and 10 per cent infection, respectively. The buffalo-calf was found completely refractory to the infection with this strain.

29. Studies on the efficacy of different anthelmintics against *Moniezia expansa* in sheep.

S. N. SAXENA and P. G. DEO, Izatnagar.

Investigations on the efficacy of eleven different anthelmintics against *Moniezia expansa* in sheep have been incorporated in this paper. Out of the eleven drugs tried 2% Copper sulphate in a dose of 75 c.c. per sheep and Sodium arsenate at the dose of 0·5 to 1·0 gm. per sheep have been found to be poisonous to the host. A mixture of equal parts of 2% Copper sulphate and 40% Nicotine sulphate given at the rate of 45 to 60 c.c. per sheep was 30% efficacious against *M. expansa*. Copper arsenate at the dose of 0·5 gm. per sheep, Paris green at the dose of 1·15 to 0·3 gm. per sheep were 60% and 80% effective against this worm. The latter drug proved to be 66·6% poisonous to the host. Arsenic trisulphide (yellow) at the dose of 0·5 gm. per sheep proved 75% effective in removing mature worms of this species. 25% Liquor fillicis given at the rate of 0·5 gm. in 1 oz. of castor oil per sheep did not have any action on *M. expansa*, but accelerated the rate of discharge of segments. Calcium arsenate at the dose of 0·15 to 2·0 gm. per lamb and 0·3 gm. per sheep was found to be harmless and 100% efficacious against *M. expansa*. Likewise lead arsenate at a dose of 0·5 to 1·0 gm. per sheep, Tin arsenate in the dose of 0·5 gm. per sheep, and Tin arsenite at the dose of 0·3 gm.

per lamb were found to be harmless and 100% efficacious against the parasite. Amongst the drugs tried, Calcium arsenate was the cheapest which had 100% efficacy against worm and had no toxic effects on the host.

30. Incidence and treatment of *Dictyocaulus Filaria* (Metastrongylidae) infection among sheep and goats.

V. P. SHARMA DEORANI, Izatnagar.

Under the survey, in all 441 sheep and goats would be available for post-morten eamination. Out of 157 sheep examined, 77 (49·9%) and out of 284 goats, 32 (11·2%) were found positive for *D. filaria* infection. Sheep and goats from plains harboured only *D. filaria* while those from hills had both *D. filaria* and *V. pneumonicus*. The number of adult worms collected from individual animals varied from 2-223 in case of *D. filaria* and 3-9 in case of *V. pneumonicus*. Sheep were generally harbouring more worms than goats. The majority of worms in bronchi and broncheoles were found lying with their oral end towards the alveolar side of the air passage. The ratio of male and female worms found at different times did not vary too much. During the summer months the infection was difficult to find so much so that the experimentally infected animals became clear of infection. During spring, rainy and autumn seasons the moderately infected cases were only available. Of course, during winters there were the maximum cases of infection on record with high intensity and enough mortality. The condition of lungs examined were varying from normal to almost all degrees of consolidation, necrosis, purulation and emphysema. Oedema and damage to pleura was also not infrequent.

Three trials to assess the efficacy of Cyanacethydrazide-"Dictycide" (I.C.I.) administered subcutaneously, in the prescribed dosage schedules were conducted. The effect of the drug on three s/c injections on first, fifth and twenty-first day was not at all appreciable, either on developing or adult *D. filaria* worms, inspite of the fact that, for adults the dose was increased by one and a half times. Three injections, one on three successive days, though are more effective against both developing and adult worms, but the efficacy among adults showed only 9-21% fall in larval count, in spite of the increased dosage. There was little improvement in general health and coughing distress of experimental animals. There is slight irritation at the site of injection but is temporary. The drug is not vermicidal but if at all is only vermifugal.

31. Pathogenicity of *Dictyocaulus Filaria* infection among sheep and goats.

V. P. SHARMA DEORANI, Izatnagar.

Invariably both left and right lungs were found involved but left lung was observed to be more so. Diaphragmatic and cardiac lobes mostly contained lesions and worms, while rarely so was the case with apical lobe. Most of the lungs in early stages were showing pale emphysematous lesions, and mucous lining of the bronchioles and bronchi was inflamed, containing thin frothy exudative fluid in the air passage. In advanced cases and particularly where the infection was heavy there were observed many small or big patches of consolidation, and here the worms inside the air-passage were seen in thick and viscid mucus. On histopathological examination the bronchial epithelium was seen proliferated and highly infiltrated with eosinophils. For the greater part of the epithelium the ciliated edge of the epithelium was not intact and at many places tattering was evident with desquamation of epithelial cells. In acute cases the exudate in the air-passage was catarrhal consisting of leucocytes or epithelial cells and sometimes was fibrinous. The bronchi and bronchioles had an increase of connective tissue in their adventitial coat, and in few the wall was swollen due to much infiltration of the exudate. Sometimes the alveolar epitheliasation was more marked and the lining cells formed a sheep of cuboidal epithelium. In some lobules, the alveoli had much exudate containing neutrophils. In chronic cases, peribronchial fibrosis was also seen.

Haematological studies on six kinds, divided in three groups, and infected with 2,000, 5,000 and 10,000 larvae each, revealed that after two months of infection there was rise in leucocytic count up to 12,500-21,200 per c.mm. and the differential leucocytic count was—lymphocyte 19-55%, Neutrophils 22-41%, Eosinophils 13-31%. There was not much change in Basophil and Monocyte percentage.

32 Pathogenesis of Ogmocotyle indica (Notocotylidae) infection among sheep and goats of Uttar Pradesh Hills.

V. P. SHARMA DEORANI, Izatnagar.

In all 17 cases, positive for this infection, diagnosed by faecal examination, were examined for these studies, at Gwaldam Sheep Farm, Pauri-Garhwal (U.P.); out of which only six and two other from Chakrata hills, Dehradun (U.P.) could become available for post-mortem examination and histopathology. The symptoms begin with lassitude and depression of spirits. Appetite becomes variable and constipation alternates with diarrhoea. In a couple of days diarrhoea completely sets in. Faeces are first followed by watery diarrhic discharge, which smells very badly and is later frothy mixed with shreds of mucous sometimes with blood and rarely with pus too. Due to exhaustion the temperature may become subnormal. This condition of enteritis continues for about a week and the animal is emaciated, rises with difficulty, reluctant to move or feed and lies prostrate on the ground. For lack of nutrition the animal becomes anaemic and visible mucous membranes become pale. In later stage respirations are deep and laboured, pulse slow and weak and finally animal succumbs. Course of illness runs from 4-10 days, ending fatally or in recovery.

On post-mortem examination the gross lesions and the parasites, in varying degree, are generally found in duodenum, jejunum and ileum; and only in one case in abomasum, which was recorded by either Bhalerao (1942) or Katiyar (1956). The worms were found both attached to the wall and in the lumen of the intestine and number collected from individual animals varied from 1,900-1,02,300. The intestines were thickened, much congested and their mucous membranes rough and denuded at many places. There were linear pinpoint haemorrhagic spots throughout the infected area.

Throughout the sections the superficial mucous membrane over the villi was showing necrotic changes and marked cellular reaction. There was desquamation of mucous lining at many places. There was lymphocytic and granulocytic infiltration in mucosa and only sometimes in submucosa. In submucosa there was increase in connective tissue and blood vessels were thickened. Muscularis mucosa was damaged at some of the places. In mucosa, some sections were showing the eggs of the worm and in few their suckers were cut. In duodenum the Brunner's glands were hypertrophied and so were Pyayer's patches in the ileum. The leucocytic count was from 12,500 to 19,300 per c.mm. and the percentage of lymphocytes and eosinophils was 40-52 and 11-23 respectively.

33. Efficacy of Trolene (Dow ET-57), Neguvon (Bayer L 13/59) and Asuntol (Bayer 21/199) against Sarcoptic Mange in goats and buffaloes.

R. P. CHAUDHURI, Izatnagar.

Treatments with trolene and neguvon at 30 mg. and 20 mg. per kg. body weight respectively orally and with asuntol and in lindane at 0·5 per cent and 0·035 per cent respectively as wash were given to goats badly affected by sarcoptic mange. Five oral dosages of trolene and neguvon although gave some relief to goats having mild scab on their bodies, did very little good to those cases where scap formation was heavy. But comparatively better result was obtained after two applications with each of the two insecticides used as wash. Thereafter the goats previously treated orally with trolene and neguvon were treated with 0·25 per cent neguvon as wash and the treatment of other goats with asuntol and lindane continued but the concentration of lindane wash was raised to 0·05 per cent. After three applications of these treatments at about weekly intervals all the goats were completely cured.

In another experiment treatments with neguvon at 0·15 per cent as wash and at 20 mg. per kg. body weight orally were given to some buffalo calves suffering from sarcoptic mange. The oral treatment was given daily for three consecutive days and after a rest for five days it was given again one day; the dermal treatment was applied twice at 5-day interval. These treatments cured the mange of the buffalo calves completely. The infection was mild and no thick scab formation took place on any of the buffalo calves treated.

34. Comparative efficacy of Sodium Sulphaquinoxaline, Sodium Sulphamezathine and Nitrofurazone 'Soluble' used as posterior prophylactics at therapeutic levels in the control of Caecal Coccidiosis *(Eimeria Tenella)* of poultry and their effect on the development of immunity to the infection.

B. S. GILL, M. N. MALHOTRA and N. B. LALL, Izatnagar.

A series of 8 trials were undertaken to evaluate the efficacy of sodium salts of sulphaquinoxaline (0·05%) and sulphamezathine (0·2%) and nitrofurazone 'soluble' (0·011% and 0·022%) administered in drinking water from 0 hour to 72 hours after infection in controlling severe, experimentally induced *Eimeria tenella* infection of 3—4 weeks old susceptible W.L.H. chicks, and also to find out the effect of such treatments upon the development of immunity to the parasite.

The pooled data revealed that treatment imitiated before the infection was 48 hours old, offered complete protection except 0·011 per cent nitrofurazone in which case heavy mortality and bleeding also occurred in chicks treated since 24th hour. Thereafter the efficiency of all the coccidiostats decreased progressively. Sulphamezathine proved the best and sulphaquinoxaline and nitrofurazone (0·022%) were about equally effective. Treatments given simultaneously with the infection and 24 hours after, interfered with the development of immunity to the infection.

35. Studies on the comparative efficacy of Sodium Sulphaquinoxaline, Sodium Sulphamezathine and Nitrofurazone 'Soluble' in the control of Caecal Coccidiosis *(Eimeria Tenell)* of poultry.

B. S. GILL, M. N. MALHOTRA and N. B. LALL, Izatnagar.

A series of eight experiments were undertaken on the comparative efficacy of sodium salts of sulphamezathine (0·2%) and sulphaquinoxaline (0·05%), and nitrofurazone 'soluble' (0·011% and 0·022%) in controlling artificially-induced and clinically-evident *Eimeria tenella* infection of susceptible chicks. Medication began immediately on the appearance of blood in faeces. The drugs were administered in drinking water, the sulphonamides according to 3-2-3 interrupted schedule and nitrofurazone for 7 days continuously. Pooled data showed that whereas 70·5% of control (untreated) chicks died of the infection, only 31·8, 46·9, 49·7 and 50 percent chicks treated with sulphamezathine, sulphaquinoxaline and nitrofurazone on lo and high levels, respectively, died. Treatment though reduced mortality considerably but did not affect bleeding which was of the same degree in the variously treated groups. Use of coccidiostats did not interfere with the development of immunity to the parasite.

36. Some observations on the incidence and biology of *Monaxi a* species in sheep and goats with a note on the pathogenesis of *Moniezaiez apnse* in sheep.

S. N. SAXENA and P. G. DEO, Izatnagar.

The results incorporated in this paper showed that the incidence of *Moniezia* species in sheep and goats at Bareilly was 28% and 22% respectively. The infection of *M. expansa* in sheep and goats was found to be 15% and 4%, while that of *M. benedeni* was observed to be 0·7% and 10·7% respectively. There was no correlation between the number of *M. expansa* present and the discharge of their segments in the faeces of sheep. There was no effect of starvation on the removal of *Moniezia expansa* in sheep. The discharge of segments was accelerated as the period of starvation of the host was progressively increased. Histopathology of *Moniezia expansa* in sheep has been studied. The mortality rate due to the infection of this parasite in sheep and lambs was found to be as high as 24 percent.

37. On the role of the Stable Fly *Stomoxys Calci rans* L. in the transmission of Surra in this country.

R. P. CHAUDHURI and PAVAN KUMAR, Izatnagar.

Transmission experiments were carried out to study the role of the stable fly *Stomoxys, Calcitrans* in the transmission of surra amongst livestock in this country. Guineapigs, dogs and ponies were to be used as experimental animals in this study. Thirteen experiments on guineapigs and four on dogs had so far been carried out.

Though in some experiments more than a hundred stable flies had been tried in each case only five to forty of them fed on the experimental animals. Flies were first allowed to feed for ½ minute to 3·½ minutes on the surra affected animals before transferring them to the healthy experimental animals for feeding for ½ min. to 5 min. Feedings were done under close observation using one fly at a time. After the transmission feedings were over the experimental healthy animals were maintained under observation at least for a month.

Thirteen experiments on guineapigs and four on dogs had so far been carried out, of these one experiment with guineapigs and one with dogs had been found to have given positive result. The study is in progress.

38. Selection of pullets on the basis of width of the back at the time of sexual maturity.

H. P. TANDON, S. P. SETHI and S. BOSE, Izatnagar.

Studies have been undertaken to find out the variations in the maximum width of the back of S. C. White Leghorn pullets and their relationship with sexual maturity and egg production to end of March. Observations were made on 128 pullets. The maximum width of the back ranged between 7·5 cm. and 11·0 cm. 68·7% of the pullets fell within the range of 8·6 cm. to 9·5 cm. 14·1% below 8·6 cm. and 17·2% above 9·5 cm.

Pullets having relatively narrower backs, maximum width 8·8 cm. or below, matured, on an average, earlier than those having wider backs. The differences in respect of mean age at 1st egg between various classes of pullets grouped on the basis of maximum width of the back were, however, non-significant. It seems that little or no relationship exists between width of the back and sexual maturity. As regards egg production to end of March, pullets having relatively narrower backs, maximum width 8·5 cm. or below, gave the lowest production. The difference in mean egg production of the various classes of pullets, grouped on the basis of maximum width of the back, were non-significant. The results, however, indicate that pullets having maximum width of the back less than 8·6 cm. on the day of 1st egg should preferably not be selected for the purposes of winter egg production.

39. Selection of pullets on the basis of body weight at sexual maturity.

H. P. TANDON, G. V. RAO and S. BOSE, Izatnagar.

Studies were undertaken to find out the variability that exists in the body weight at 1st egg in White Leghorn pullets and its relation with age at 1st egg and winter egg production.

Observations were initiated on 209 pullets. Body weight at 1st egg ranged from a minimum of 1080 gms. to a maximum of 2588 grams with a standard deviation of 220·4 grams. 81·8% of the pullets fell within the range of 1301 to 1900 grams.

Lighter pullets matured earlier than the heavier ones and a positive correlation of 0·40 was obtained between age at 1st egg. and weight at 1st egg.

Differences in respect of winter egg production (till the end of March) between pullets of lighter and heavier body weight groups were non-significant. A negative correlation of −0·2 was obtained between weight at 1st egg and winter egg production.

40. Record of Individual Hen's Egg Production without Trapnesting.

R B. L. SRIVASTAVA and S. BOSE, Izatnagar.

Trapnesting though used all over the world for measuring individual hen's egg production, is not practised by the average Indian Poultry Keepers, as owing to its limitations, it does not suit the village conditions.

Experiment was, therefore, conducted to standardise a method of recording individual hen's egg production by palpation without the use of trapnests. Eggs were felt by palpating over the abdominal region by the tip of the fingers and most of the hens which were found positive in the morning, laid during the day excepting a few which carried eggs over to the next day. When hens were handled early in the morning and leg band numbers of those found positive noted, the number of eggs found during the day usually tallied with the number of birds found positive in the morning. In cases where the number of eggs were less, the hens which did not lay could be detected by palpating in the evening. The remaining hens were then credited with one egg each. This simple method can very easily be used by the village poultry keepers for recording individual hen's egg production.

1. Studies on the histopathology of Avian Spirochaetosis.

V. V. SRINIVASAN, Izatnagar.

Spirochaetosis is an important septicaemi cdisease caused by Borrelia anserina Spirochaeta gallinarum) and is characterised by high morbidity and mortality.

A review of current literature on the histopathological studies of spirochaetosis, ndicates that much work has been done only on Turkeys and there is lack of nformation on the microscopical changes of the affected tissues of fowls suffering rom the disease. This prompted the author to undertake the investigation. tudies on the histopathological changes of spleen, liver, lungs, kidney, intestines, eart and brain of birds died 72-90 hours after artificial infection were made and he findings have been presented in this paper.

The myocardial fibres showed extensive degenerative changes with increased ranularity. The spleen showed distinct hyperplasia of reticular cells in the nalphigian corpuscles with the formation of reaction centre The liver revealed narked dissociation of hepatic cords and consequent potency of the sinusoids which vere infiltrated with heterophiles. The lungs showed foci of atelectasis and consoidation. The kidney depicted a picture of subacute glomerulo-nephritis. The inestines did not show much appreciable changes except for the disorganisation of he epithelial cells. The brain showed degenerative changes in the neurons.

Further studies are also being made to find out if there are differences in issue changes by different strain at various intervals.

42. The Histopathological studies of Chronic Respiratory disease in Fowls.

V. V. SRINIVASAN and S. B. V. RAO, Izatnagar.

In the beginning of the year 1961, an outbreak of Chronic Respiratory Disease occurred in the growing stock of chickens of the Indian Veterinary Research Institute Poultry Farm, in which pathogenic pleuro-pneumonia-like organisms were incriminated as the sole cause of the disease. Since the lesions mainly involved the rachea, lungs and airsacs, the histopathological studies were confined to these rgans.

Studies of the affected tissues of the birds in both natural and artificially inected cases, have been made and a detailed description has been presented in his paper.

The trachea revealed a picture of acute catarrhal tracheitis with lymphofolliular hyperplasia. The lungs showed, in rare cases, some changes associated with ronchopneumonia. The lamina propria of the airsac was thickened with serous xudate. The infiltration of the mononuclear cells was observed at scattered areas.

In cases of birds artificially infected, the changes were not so pronounced as bserved in the natural cases. The changes were, however, more inflammatory in nature.

The histopathological findings of the authors did not differ much from that of the workers abroad, who have studied this aspect of the disease as well.

43. Studies on the Immunization of day old chicks against Fowl pox with Fowl pox Virus modified by serial passage in duck embryos.

S. B. V. RAO and K. K. AGARWAL, Izatnagar.

Fowl pox embryonated Vaccine Virus (F.P.V.) Rao's strain was serially passaged in duck embryos with a view to attenuate its virulence for immunising day old chicks. The F.P.V. was adapted to the Chorio-allantoic membrane (CAM) of t duck embryos after twenty serial passages resulting in takes in the form discre plaques spreading over the entire area of the CAM which became highly oedematou Preliminary trials at immunization of day old chicks with duck-embryo-modifi FPV at the twentieth passage level with a 5 per cent suspension of the infect CAM in glycerine/saline by wing-web puncture as well as by follicular method ga satisfactory takes without metastatic lesions, generalization or systemic reaction any type. All the vaccinated chickens were refractory to challenge with Virule fowl pox Virus for four months after vaccination up to which time the month tests were conducted. Further immunity trials are under progress.

44. Studies on Chronic Respiratory Disease of chickens in India. Part I. Th isolation and identification of a pathogenic strain of PFLO (Mycoplasm gallinarum).

P. G. PANDE, S. B. V. RAO and K. K. AGARWAL, Izatnagar.

The occurrence of an outbreak of respiratory disease on a large North India farm is described in a flock of 3,000 growing chickens. The disease involved bot the upper and lower respiratory passages. Over a 1,000 birds were affected an about forty per cent succumbed. But the morbidity was more marked than mortality. The symptoms were, rhinitis, sinusitis, laryngitis, respiratory distress resulting in audible rales and grasping, oedema of face and conjunctivitis, tracheitis aero-cystitis, pneumonitis, and marked thickening of the air sac membranes. Yello cheesy exudate was observed in the trachea and air-sacs, while hyperplasia of the tracheal mucosa, representing lympho-follicular reaction was observed in sections. Pleuro-pneumonia like organisms were isolated in PPLO (modified Grumbles) media, and in embryos. They were classified according to Sabin's criteria (1941) as PPLO. Colonies grew in enriched serum agar plates inside the media, and morphologically confired to the pattern described by Chu (1958). The organisms produced identical disease in 13 to 18 days in 100 per cent of the susceptible chickens obtained from a flock unexposed to the disease.

Pathogenic PPLO were similarly isolated from heavy mortality from week-old brooder chicks on the same farm with lesions of congested trachea suggestive of an egg borne nature of the disease.

Chemotherapy with a certain combination of antibiotics has given encouraging results.

45. Influence of feeding urea as a partial protein substitute on milk yield and butter fat production in buffaloes.

P. C. SAWHNEY and S. C. GUPTA, Izatnagar.

Sixteen buffaloes of about the same age and general condition were selected from the Institute Dairy and divided into four groups of four each on the basis of their lactation number, days in milk and average milk yield. Treatments were offered at random, which comprised of one control and three experimental. In the experimental groups, 10, 20 and 30% of the digestible crude protein requirement of the animals was met by urea. The animals in control group received dairy mixture and wheat *bhoosa* (*ad lib.*) as roughage, whereas, in the experimental ones, the alloted requirement of protein was met by urea and the rest by dairy mixture. Each experimental group ration was made isocaloric with that of control by the addition of requisite amounts of starch, and, in addition, each animal was offered one ounce of dairy mineral mixture supplement every day. Greens were ed during the available season after making necessary deductions from the dairy nixture for its protein content. The maintenance ration was kept constant and he ration for milk production was changed at fortnightly intervals depending upon he milk production and butter fat percentage of the animals.

Feeding on the above pattern was continued for a period of full one lactation. 'he milk yield of each animal was recorded, both for morning and evening, every ay and the fat percentage was determined twice a week.

The first 24 weeks' data of total milk yield, butter fat produced and fat orrected milk (corrected up to 4% fat), when subjected to analysis of variance, lid not indicate any significant difference in between the groups in all the three ases. The average respective (Control, 10% D.C.P. replacement level, 20% and 0%) group-size figures were : 2024·50, 1966·25, 1957·75 and 1979·75 lb. (with a tandard error of ±153·0) ; 138·70, 130·11, 131·08 and 130·82 lb. (with a standard error f ±14·44), and 2888·75, 2734·50, 2749·00 and 2746·00 lb. (with a standaard error of ±179·0) for total milk yield, butter fat produced and fat corrected milk (to 4% fat) espectively.

16. Urea enriched Sugarcane Bagasse as cattle feed.

V. MAHADEVAN, M. M. JAYAL and P. S. GUPTA, Izatnagar.

A cattle-feed-mixture with 50% sugarcane bagasse, 20% wheat *bhoosa*, 20% heat bran, 5% molasses, 2% urea, 2% mineral mixture and 1% salt was prepared vhich gave the following percentage chemical composition :

C.P., 11·56; E.E., 1·23; C.F., 35·68; N.F.E., 43·75; Ash, 7·78; Calcium (Ca), ·52 and phosphorus (P), 0·48.

For conducting a feeding trial the cattle-feed-mixture was fed *ad lib.* to three *Iariana* bullocks for 30 days. Each animal was given 1 kg. of green berseem laily. A metabolism trial was conducted during the last 10 days.

The experimental animals on an average, consumed 1·46 kg. of the total ration n dry basis, per 100 kg. body weight per day.

The average digestibility coefficients of the feed-mixture were : C.P., 75·00; .E., 69·35; C.F., 49·41 and N.F.E., 53·37. The D.C.P. and T.D.N. values in kg. er 100 kg. of the feed-mixture, on dry basis were 8·67 and 51·57 respectively. The nimals maintained positive balance for nitrogen, calcium and phosphorus.

7. Effect of feeding urea as a partial protein substitute on the digestibility and metabolism of milch buffaloes.

P. C. SAWHNEY and S. C. BISARYA, Izatnagar.

Twelve buffaloes at post-peak lactation were divided into four groups of three ach on the basis of their milk yield, butter fat percentage, lactation number, days n milk, live weight and breed. The four groups were offered four different treatnents, i.e., one as control and the other three receiving 10, 20 and 30 per cent f the digestible crude protein requirements by urea, at random. The control roup was maintained on the normal dairy mixture plus wheat *bhoosa ad lib.* as oughage, whereas, in the other three groups, alloted requirements of proteins was ne by urea and the rest by dairy mixture. Wheat *bhoosa* was offered *ad lib.* as oughage. Rations in the experimental group were made isocaloric as compared control by the addition of requisite amounts of starch. The above ration was dequately supplemented with common salt, dairy mineral mixture and vitamin A.

After a preliminary feeding of 12 weeks, a metabolism trial lasting for 10 da was conducted. The average digestibilities of crude protein, ether extract, cru fibre and nitrogen-free-extract were found to be 53·4, 56·0, 56·0 and 56·0; 69· 44·0, 45·9 and 49·3; 58·5, 61·3, 57·5 and 51·6, and 55·1, 59·0, 59·4 and 63·9, respectivel for the group serving as control and others receiving urea at 10, 20 and 30% the animals' D.C.P. requirements, respectively. The balances of nitrogen an minerals were positive in all the groups, on the average and dry matter and tot digestible nutrients, ingestion per 100 lb. live weight were 1061·3, 1064·7, 1145· and 1136·2 gms. and 557·3, 582·5, 619·0 and 623·3 gms. respectively in the four group

From the above observations, it will be seen that, with the exception of th average digestibility of figures for ether extract; the other characters have littl if any, difference in between the groups. In the case of ether extract, the variatio in digestibility figures might have been partly due to the lowered ingestion o ether extract from the dairy mixture in the experimental groups.

48. Clinical Syndromes and Histopathological changes in Natural cases o Vitamin 'A' deficiency in Cow Calves.

BRAHM DUTT and B. VASUDEVAN, Izatnagar.

Vitamin 'A' deficiency causes a variety of clinical and pathological lesions i different species of animals. The only common clinical symptom in vitamin 'A' deficient animals is night blindness.

A few clinical cases of vitamin 'A' deficiency in calves were observed in the dairy herd of the Indian Veterinary Research Institute, Izatnagar. The calves showed opacity and ulceration of cornea, rough coat and had frequent attacks of diarrhoea and convulsions. The calves were completely blind. Histopathological studies of the tissues obtained from the two vitamin 'A' deficient calves revealed that the pseudo-columnar epithelium of the interlobular ducts of the parotid gland had been replaced by multilayered stratified squamous epithelium. The histological changes in other tissues were just non-specific associated with inanition The parotid gland in bovine is therefore the only tissue which shows pathognomonic changes of metaplasia in vitamin 'A' deficiency.

49. A clinical case of hypothyroidism in a ram.

B. DUTT and B. VASUDEVAN, Izatnagar.

One ram of the Animal Nutrition Division was seen to be going down in condition progressively. The clinical symptoms shown by the ram could not be associated with any bacterial or viral infection. Supplementation of the diet with trace minerals and vitamin (A, D and E) proved unavailing. Deworming of the lamb for possible helminthic infection had also no effect.

The ram on autopsy showed a cystic thyroid gland with a very thin and atrophied parenchyma enclosing the cyst.

On histological examination, the thyroid revealed big cysts containing colloid material bordered by a thick capsule. The parenchyma bordering the cysts was atrophied and replaced by fibrous tissue. The acini, a little away from the cyst wall were also atrophied and separated by myxomatous tissue. Histological examination of testes showed absence of spermatogenesis. The pituitary gland showed hyperplasia of basophil cells,

50. Influence of Copper and Cobalt Supplementation on the Growth of Hariana Calves.

V. S. BISARIA and V. MAHADEVAN, Izatnagar.

Three groups of young calves aged about 2 months eight in each group consisting of four females and four males, have been grouped at random taking the age and body weight into consideration. All the calves were given a basal ration consisting of what *bhoosa*, greens and calf mixture which is composed of 40 parts wheat bran, 30 parts ground nut cake and 30 parts of barley. The ration was rendered adequate in all respects by feeeding required amounts of vitamins A, D and E, 14 gm. dicalcium phosphate, 14 gms. salt and the D.C.P. and T.D.N. were adequately met with according to Sen's feeding standard. The control group received the basal ration only, while the 2nd group received the basal ration and 6·3 mgm. of Cu and 0·05 mgm. of Cobalt as copper sulphate and cobalt chloride respectively. The third group received only 6·3 mgm. of Cu as supplement as copper sulphate. The levels of supplement continued to be the same throughout the experimental period from 2 months of age to one year.

Weekly body weights of the calves have been recorded, and adjustments were made in the calf mixture ration for each animal to supply the required levels of D.C.P. and T.D.N.

The control growth rate per week for 80 kg. body weight in all the groups were 1·45 kg. for control, 1·57 kg. for cobalt and copper supplemented group and 1·43 kg. for copper supplement group. Copper and Cobalt supplementation has surpassed all the other two groups in the growth rate during a period of 10 months. In the copper supplemented group even though the growth rate was not exceeding the copper and cobalt supplemented group, it was better than the control group.

When the growth rate is estimated up to 6 months of age the growth rate trend observed was highly significant. The corrected growth rate in the case of Cu and Co group as well as Cu group alone as compared with that of the control for 48 kg./week was 1·29 kg. for control, 2·24 kg. for copper and cobalt group and 1·62 kg. for copper supplemented group.

Copper and cobalt supplementation at the above levels influence a better growth rate than copper alone in young growing calves even though the ration used is not deficient in copper and cobalt.

SECTION OF AGRICULTURAL SCIENCES

President :—PROF. P. K. SEN, M.Sc., Ph.D. (Lond.), D.I.C., F.B.S.

Abstracts.

AGRONOMY

1. Assessment of water for irrigation from climatological data.

A. P. BHATTACHARYA, Roorkee.

Water requirements of three principal crops of Uttar Pradesh, namely, wheat, rice and sugarcane, are under experimentation at a number of stations in U.P. ever since 1942-43. A number of standard formulae, utilizing climatological data alone were tested against the experimental results to provide a check-up. This year, only the observational data for wheat at Dhanauri (near Roorkee) for the years 1956-57, 1957-58 and 1960-61 was utilised in this approach.

Lowry-Johnson method, evolved by the United States Bureau of Reclamation, using the accumulated heat or effective day degrees (accumulated maximum temperatures in °F above 32° F during the growing season), gave quite high figures.

The best method was found to be that advocated by H. F. Blaney of the United States Department of Agriculture in view of the close analogy of the theoretical figure of 8·31 inches with the experimental result of 8·50 inches, besides its simplicity.

Excellent fit was also obtained with the Penman formula, evolved by Dr. H. L. Penman of the Rothamsted Experimental Station, but the calculations were lengthy. Based on this, the results of the Van Bavel (of the Virginia Experimental Station, U.S.A.) formula also gave reliable results.

The fit obtained by the Hargreaves formula was satisfactory. Figures obtained on the basis of the Thornthwaite formula were rather high.

2. Study of the response of rice to different levels of organic manures and inorganic fertiliser.

B. N. SAHU, Bhubaneswar.

For getting information on the relative value of Organic manures such as Green manure, Oilcake and Farmyard manure and Inorganic fertiliser alone and in combination on the productivity of rice soils, a field experiment has been laid down in Agronomy section of the State Agricultural Research Station, Bhubaneswar Orissa since the year 1956-57. The experiment has been laid out in a split-plo design; the organic manures have been applied in the main plots and the levels o Nitrogen in the sub-plots, the organic manures tried are Farmyard manure, Green manure with Sanhemp and groundnut oilcake to supply 40 lbs. Nitrogen per acre while the Inorganic fertiliser is being applied as Ammonium sulphate to supply 20, 40, 60 and 80 lbs. Nitrogen per acre. There is one No manure plot both in the main and sub-plot treatment as control. The experiment has been laid out in replications with twenty plots in each. A long duration Paddy variety T90 is being grown every year. The experiment is being continued at the same site without any change in randomisation. The paper presents the results obtained during the seasons 1956-57 to 1960-61.

The results indicate that the control plot has given the lowest yield, 1,732 lbs. per acre, whereas all Organic manures have given an appreciable increase in yield.

There does not appear to be very much difference due to the application of Farmyard manure and groundnut oilcake.

Farmyard manure has given lower yield than that of green manure. The great variability in the composition of bulky and semibulky manures has to be taken into consideration while assessing their effect on the yield and their relative efficiency.

Amongst all levels of Nitrogen applied as Ammonium Sulphate alone, maximum yield of 1,913 lbs. has been obtained at 60 lbs. per acre and thereafter the yield decreases.

There seems to be positive reaction between Farmyard manure and green manure with Ammonium sulphate. Highest yield has been obtained with 40 lbs. of Ammonium sulphate superimposed over a basal dressing of 40 lbs. Nitrogen as farmyard manure.

Groundnut oilcake when applied alone @ 40 lbs. Nitrogen per acre has given a yield of 1,865 lbs. of grain per acre whereas the yield decreases when Ammonium sulphate is superimposed at the graded dose. The interaction is therefore negative.

On the basis of the above experimental data it is seen that maximum yield of paddy can be obtained either by application of Farmyard manure to supply 40 lbs. of Nitrogen followed by 40 lbs. Nitrogen as Ammonium Sulphate or by green manuring with Sanhemp so as to supply 40 lbs. Nitrogen supplemented by application of 40 lbs. of Nitrogen as Ammonium Sulphate.

3. Efficiency of different nitrogenous fertilizers for rice production in laterite soils of Orissa.

I. C. MAHAPATRA and B. N. SAHU, Cuttack.

Field experiments are in progress at the Agronomy Section of the State Agricultural Research Station, Orissa since 1955-56 to study the relative efficiency of different nitrogenous fertilizers for rice crop in acidic sandy loam laterite soils of Bhubaneswar @ 20, 40 and 60 lbs. N. per acre in the forms of Ammonium Sulphate, Ammonium Chloride, Urea, Ammonium Sulphate Nitrate and Calcium Ammonium Nitrate. A long duration variety, T. 1242 (160 days duration) was grown in the experiment. The results of the first four years, 1955-56 to 1958-59, are discussed.

The results revealed that application of all fertilizers tried gave a substantial increase in rice yield. Ammonium Sulphate is the most efficient fertilizer among the five forms tried, but there were no significant differences among them. The relative ratings of Ammonium Sulphate Nitrate, Ammonium Chloride, Calcium Ammonium Nitrate and Urea are 99·24, 94·96, 93·81 and 92·18 respectively taking Ammonium Sulphate as 100. The grain yield response is linear upto 60 lbs. N. per acre. There is differential response due to season in case of most of the fertilizers. Ammonium sulphate gave maximum yield of 2369 lbs. per acre at 40 lbs. N. level while rest of the fertilizers yielded their maximum at 60 lbs. N. per acre. All the five forms tried could be used as alternate fertilizers, the selection of which will be determined by the cost per lb. of nitrogen.

4. Chemical weed control in Wheat and Paddy fields.

A. P. MANI, Kerala State.

Detailed investigations on field scale in replicated blocks have been carried out in the Shyamnagar Farm of the Bose Institute on the feasibility and effectiveness of chemical herbicides such as Cornox-M, Fernoxone and Crag Herbicide-1 in controlling weeds in wheat and paddy fields, the data in every case being statistically analysed.

The appropriate time of application of herbicides in a standing crop and its implications have been clearly brought out. However, the necessity of taking into account the nature of weed growth in fixing the time of treatment is also clearly indicated.

The optimum dosage of Crag Herbicide-1 which can be recommended for weed control in wheat and paddy fields has been found to be 5 lbs. per acre. In addition to the effective control of weeds, treatment with "Crag" has produced an increase in yield over the manually weeded control in paddy.

A comparative study of Cornox-M and Fernoxone in wheat and paddy fields has shown that the latter is a better herbicide in both the crops. Treatment with Fernoxone has yielded as good a result as manually weeded control in wheat crop.

The problem of eradication of noxious weeds such as *Cyperus rotundus* and *Cynodon dactylon* has been fully discussed and it has been shown that by a timely and judicious application of Fernoxone both the weeds can be controlled in paddy and wheat fields with a fair degree of satisfaction without harmful effects to the standing crops.

The economics of chemical weed control has been worked out in both the crops. It has been found that chemical weed control is more economical and efficient than manual weeding. However, the necessity of producing cheaper chemicals or making them available to the cultivator at subsidised rate has been indicated.

5. Tillage experiment on rice : Study of the comparative efficiency of different tillage practices with an iron and country plough on the yield of rice.

B. N. SAHU, Bhubaneswar.

In the 'dry' and 'semi-dry' systems of cultivation of rice in Orissa, number of ploughing is given in Summer with a country plough for obtaining a good tilth. In the 'Wet system' the field is puddled by repeatedly ploughing three or four times with an interval of about four days between each ploughing and levelled before transplanting. For getting information on the relative value of preparing land with an Iron plough and country plough and ploughing in different months a field experiment was laid out in the Agronomy Section of the State Agricultural Research Station, Bhubaneswar, Orissa. The experiment was laid out in a split plot design in three replications having twelve plots in each block, ploughing with an Iron plough and Country plough in the main plot and the ploughing as per the schedule indicated below in the sub-plots.

Mainplot Treatment :

(i) Ploughing with Iron plough.
(ii) Ploughing with Country plough.

Sub-plot Treatments :

(1) Ploughing once in every month after harvest of the previous crop.
(2) Ploughing in every alternate month (3 ploughings).
(3) Ploughing once in every third month.
(4) Fallow till July, puddling and transplanting.
(5) Fallow till August, puddling and transplanting.
(6) Normal practice or ploughing in January after the harvest of the previous crop, puddled and transplanting in July (Control).

A long duration paddy variety T. 1242 was grown in the experiment. The experiment is being conducted in the same site without any change in the randomisation of treatments. The paper presents the results obtained during the seasons 1959-60 and 1960-61.

The yield data indicate that (1) ploughing and puddling with Iron plough is superior to that with country plough, (2) in the 'Wet system' of rice cultivation ploughing and puddling the field in July and transplanting rice is superior to any other system of ploughing and preparation of land.

6. Seasonal variations in growth and yield of Aus, Aman and Boro paddy.

B. N. GHOSH, Chinsurah.

Three varieties of aus paddy: Kele, Jhanji-34 and Satika; three varieties of aman paddy: Badkalamkati-65, Rupsail and Latisail, and four varieties of boro: Chinsurah boro-1, Chinsurah boro-2, Jagal-IX and Bhogjira-III, were grown in the Kharif (wet) and boro (dry) seasons to study the seasonal effects on the growth and yield. The experiment was laid out in randomised blocks with four replications.

The height of the plant and the length and breadth of the flag leaf became shorter during the boro season than when grown during kharif, irrespective of aus, aman and boro. However, the reverse is the case in respect of tillers, i.e., more number of tillers were produced during boro. It seems that high temperature, high percentage of relative humidity, more rainfall and less hours of bright sunshine are favourable weather factors for height of the plant and length and breadth of the flag leaf, whereas the reverse is true in respect of tillers, i.e., low temperature, less rainfall, low percentage of relative humidity and more hours of bright sunshine are essential climatic factors for the production of tillers.

The length of earheads became shorter in all the varieties in boro season, except in Satika and in aman varieties, particularly in Badkalamkati-65, where an appreciable increase was recorded.

Early flowering was observed in boro varieties when grown during kharif and that of aus varieties became late when grown during boro and vice versa. Regarding aman varieties, they took a much longer time to flower during kharif, but flowered almost simultaneously with those of aus and boro during the boro season, thereby indicating that the ear emergence of these varieties of aus, aman and boro begins at the time when the day-length is between 11·32 and 12·58 hours, irrespective of the season.

All the varieties gave significantly larger yields of grain and straw in the boro season, except Rupsail, in comparison to the grain and straw yields in kharif. An appreciable increase is noticed in Jhanji-34, Satika, Latisail, Badkalamkati-65, Chinsurah boro-1, Chinsurah boro-2 and Jagal-IX. This indicates a preference of the paddy varieties, irrespective of aus, aman and boro, for dry season when temperature and bright sunshine hours are high and plenty with less rainfall and low percentage of relative humidity during the flowering and grain formation period.

From the above result, it can be concluded that Latisail and Badkalamkati-65 (both aman) can be successfully grown twice a year during the kharif and boro seasons along with suitable varieties of aus and boro. Further studies with other aman varieties are in progress.

7. Chemical composition of different types of tobacco grown on goradu soil.

K. A. PATEL and B. V. MEHTA, Anand.

Chemical composition of different types of tobacco viz., bidi type (K-49, K-20, S-12, S-20, G-6 and Sokhadiu), chewing type (P-90, P-98, P-4 and S-57), higher grade cigarette type (Delcrest, Chatham, Harrison Special, Hicks Special and Virginia Gold), lower grade cigarette type (Dumbara and G.F.T_2) and hookah and snuff types (Raskaliu and Calcuttia) grown on *goradu* soil of Anand by the standard methods, was studied by determining important constituents such as nitrogen, nicotine, total sugars, starch, wax-resins, total volatile bases, volatile oil, ash, acid-soluble mineral matter, calcium, magnesium, potassium, phosphorus, sulphur and chloride. From the results obtained it is concluded that the different types of tobacco have the following characteristics :—

Bidi tobacco :—high nitrogen, nicotine, total volatile bases, wax-resins, volatile oil and low total sugars contents. Chewing tobacco :—high nitrogen, total volatile bases, wax-resins, volatile oil, calcium, chloride, fairly high nicotine and low total sugars contents. Higher grade cigarette tobacco :—high total sugars and low nitrogen, nicotine, wax-resins, total volatile bases, volatile oil, calcium and chloride contents. Lower grade cigarette tobacco :—fairly high nitrogen, nicotine, total sugars and volatile oil and low wax resins and chloride contents. Hookah and snuff tobacco :—high nitrogen, nicotine, total volatile bases, wax-resins, volatile oil and chloride and low total sugars contents.

8. Expected leaf-burn order of different varieties of tobacco from their chemical composition.

K. A. PATEL and B. V. MEHTA, Anand.

In case of smoked tobacco, the ability of the leaf to burn is an important criterion of the quality. It is recognised that there is a favourable influence of potassium and unfavourable influence of chloride and nitrogen on leaf burn. Sastry and Kurup obtained a positive correlation between leaf-burn and the ratio $\frac{K_2O}{N+Cl}$. In the present study the expected leaf-burn order of 15 different varieties of tobacco grown on *goradu* soil has been worked from the chemical composition by calculating the ratio $\frac{K_2O}{N+Cl}$. The decreasing order of leaf-burn is :—higher grade cigarette>lower grade cigarette>bidi type>hookah type. Among higher grade cigarette varieties, Harrison Special and Virginia Gold are at the top. Among bidi varieties, the Nipani variety S-20 has better burning quality than the two Gujarat varieties K-49 and K20.

9. The performance of some newly introduced varieties of flue-cured tobacco with special reference to qualities of commercial importance.

G. S. MURTY, Rajahmundry.

The paper deals with the comparative performance of a number of flue-cured varieties that have been recently introduced into India by the Central Tobacco Research Institute, Rajahmundry. The varieties were tested in replicated trials at the Institute's Farm at Katheru during 1960-61. The data indicated that a variety's potential to produce top grades does not really depend upon its capacity to produce a high green leaf yield. Thus, Hicks, which is a poor performer in so far as green leaf yield is concerned, is the most promising variety in regard to bright grades and Total Bright Leaf Equivalent. As quality is the chief criterion to assess a variety in flue-cured Virginia types, it can safely be said that Hicks is about the best variety amongst all the varieties tested. It has the best bright grades and Total Bright Leaf Equivalent in spite of the fact that the total green leaf yield it produced did not match with other varieties. It is encouraging to note that its performance has been consistently good even when compared to last year's results.

White Gold, which had the poorest performance so far as the green leaf yield is concerned, ranked next only to Hicks in its bright leaf yield and Total Bright Leaf Equivalent, while Putcha, a variety which is not well favoured by the trade, in spite of producing a very high green leaf yield revealed its incapacity to produce a correspondingly higher yield in bright grades and Total Bright Leaf Equivalent.

In such of those varieties where the green leaf yield was significantly high, yet the final Total Bright Leaf Equivalent was poor, it is to be presumed that the variety produces a high proportion of low grades. To this category belong such varieties as R. 21 and H. a. Karedu, a 'mongrel' type, appears to have a uniform performance in all the four categories of assessment. The keeping quality of Karedu is rather poor and it is known to fade in colour. But for this handicap it is a variety to reckon with.

The synthetic types S.A. 40-31 and 40-15 are potentially good varieties as the data indicate. However, their leaves are poor in texture and body and if improvement is effected in this direction the varieties promise to stand comparison with Delcrest—the variety generally accepted by the trade at present. Planned hybridization programmes are already under way in this direction.

The varieties Bissettes and Putcha showed negative response to topping in respect of total green leaf yield. Harrison Special, Chatham and Virginia Bright showed negative response to topping for cured leaf. Super Gold and S.A. 40-18 had negative response for Total Bright Leaf Equivalent. The varieties that gave the best response to topping were D.B. 244 for green leaf, Harrison Special and R. 21 for cured leaf, and Bottom Special and Vamorr-50 for Total Bright Leaf Equivalent.

10. Effect of cultural treatments on the carbohydrate content at different stages of growth of Pachyrhizus angulatus tubers.

B. PARIJA and P. C. PARICHA, Bhubaneswar.

An experimental investigation on the tubers of *Pachyrhizus angulatus*, Rich. was undertaken to find out the carbohydrate changes, the trend of growth during tuber development and the influence of cultural treatments on the carbohydrate fractions at maturity.

A randomized block design with four replications was adopted for the cultural treatments : (i) growing the plants in flat beds, (ii) growing the plants in the ridges, (iii) staking the plants and (iv) non-staking.

The glucose content increased slowly up to the second month and it maintained a steady value thereafter. Reducing sugars at this stage seemed of no importance except to maintain a steady supply for oxidation. The sucrose content, except in the initial stages, was higher than that of glucose throughout. The maximum percentage of glucose was 2·4 and that of sucrose was 3·0, at the end of the second month. Starch content rose steadily to a maximum of 6·9 per cent. The decrease in sucrose coincided with the increase in starch indicating the possibility of conversion from one form to the other. The dry matter increased progressively. Starch content in the tubers grown in flat beds without staking was significantly higher possibly due to less destruction in the tubers or greater translocation into the tubers.

AGRICULTURAL CHEMISTRY

11. Distribution of cobalt in some typical profiles of Gujarat.

K. G. REDDY and B. V. MEHTA, Anand.

Cobalt has assumed importance in agriculture because of the relationship between the cobalt content of fodders and animal nutrition. Cobalt is accumulated from soils by plants which in turn become the primary source of cobalt for animals. From the available cobalt contents of 48 representative surface soils of Gujarat it was found that about one-third of the soils contained less available cobalt than necessary for growing pastures suitable for the normal health of cattle. As deep-rooted crops get nutrition from the sub-soil also, it was thought useful to assess the cobalt status of six soil profiles of Gujarat viz. (1) *goradu* soil of Anand (Kaira), (2) medium black soil of Chharodi (Ahmedabad), (3) black cotton soil of Athwa (Surat), (4) brownish calcareous soil of Padadhari (Saurashtra), (5) blackish calcareous soil of Pratapgadh (Saurashtra) and (6) greyish calcareous soil of Morakhada (Saurashtra). It is found that the sub-soil layers of all the soil profiles contain more total cobalt than the surface layers. The available cobalt per cent of total cobalt varies from 0·5 to 4·8. The available cobalt content of *goradu* soil of Anand decreases with depth from 0·60 ppm. in the surface layer to 0·10 ppm. at a depth of 6 ft. In the top layer of medium black soil of Chharodi it is only one-third of that in the corresponding layer of *goradu* soil, but does not decrease with depth. The top layer of black soil of Surat contains about one-half the amount of available cobalt found in *goradu* soil and decreases with depth. In Padadhari soil of Saurashtra, it is 0·27 ppm. in the top soil but increases with depth, while quite the reverse trend is seen in greyish soil of Morakhada in Saurashtra. In blackish soil of Pratapgadh, the top six inch layer of soil is low in available cobalt (0·15 ppm.), which first decreases to 0·10 ppm. in the next six-inch layer but again increases to 0·35 ppm. at a depth of 2 ft. Out of 6 profiles studied, *goradu* soil of Anand, black soil of Surat, brownish calcareous soil of Padadhari and greyish calcareous soil of Morakhada contain in the surface soil more than 0·25 ppm. available cobalt, a value suggested by Mitchell and Stewart for healthy pastures. But except in Padadhari soil profile, all the others have available cobalt content less than 0·25 ppm. at some depth and more at another depth. Hence whether the amount of available cobalt will be sufficient to maintain pastures which are healthy for animals will depend upon root distribution at different depths.

12. Distribution of copper in typical soil profiles of Gujarat.

V. NEELKANTAN and B. V. MEHTA, Anand.

Copper is one of the links that constitute the chain of inorganic elements that have been conclusively shown to be essential for the healthy and normal growth of plants. Neelkantan and Mehta studied the copper status of 64 surface soils of Gujarat and found that except for a sandy soil in Sabarkantha Dist., all the surface soils are well supplied with available and total copper. Since fruit trees and other crops with a deeper root system obtain their nutrients from the sub-soil also, the present study was initiated and available and total copper distribution in six typical profiles of Gujarat viz. *goradu* soil of Anand (Kaira), medium black soil of Chharodi (Ahmedabad), black soil of Athwa (Surat), brownish soil of Talagana (Saurashtra) and greyish soils of Padhiarka (Saurashtra) and Morakhada (Saurashtra) determined. Maximum accumulation of available copper is found in the top layer of *goradu*, black and medium black soils but this is not the case with calcareous soils of Saurashtra. Only in black soil of Surat, maximum total copper content is found in the top soil, while in the remaining soils it is found at a depth below 2 feet or more. The soils in the present condition contain sufficient amounts of total and available copper.

Factors such as pH, organic matter and finer fractions of the soil, which are reported to affect the total or available copper contents, have been studied. It is found that there is no significant correlation between any of these factors and total or available copper contents in *goradu* and calcareous soil profiles. In medium black and black soil profiles there is a significant positive correlation between total and available copper contents, between soil, finer fractions and total copper contents and between finer fractions and available copper contents.

13. Availability of Phosphate in an acidic red loam soil.

A. K. RAI, C. R. PRASAD and S. C. MANDAL, Kanke (Ranchi).

Available phosphate studies were made in an acidic red loam soil at Kanke Farm in Bihar. These studies were conducted in course of an experiment on response of crops to lime and fertilizers. It was generally found that even though lime increased the yields of these crops the available phosphate content of this soil, as determined by the method of Bray and Kurtz, did not increase due to liming. On the other hand there was a definite increase of phosphate concentration in plant leaves in the limed plots, indicating higher uptake of phosphate by plants due to liming. Phosphatic fertilizers applied along with nitrogenous and potassic fertilizers generally increased the available phosphate content of this soil. The increase in phosphate concentration in leaves from the fertilizer treatment was somewhat identical with that obtained from the lime treatment. Lime applied in conjunction with fertilizers pushed the phosphate concentration in leaves still further. These studies suggest that leaf analysis would provide a better index for phosphate availability than soil analysis and it should be resorted to wherever possible. Liming of acid soil distinctly results in higher uptake of phosphates.

14. Clay minerals in Ganges silt.

B. CHATTERJEE, Howrah.

Attempts have been made to determine the nature and relative amounts of clay minerals present in Ganges silt collected at Barrackpore (Palta) during the pre-monsoon and monsoon periods. Studies have been made of the chemical, electrochemical and differential thermal characteristics of the clay fractions isolated from these silts. The chemical and electrochemical data indicate that monsoon silt contains more illite compared to the premonsoon silt sample. D.T.A. data, on the other hand, attribute a more or less similar clay mineralogical make-up of he silt samples collected during the monsoon annd premonsoon periods. Thus, results based on the measurement of any single-valued soil characteristic may often lead to erroneous conclusion.

15. Studies on humification in a tropical red loam soil—I.

C. R. PRASAD and S. C. MANDAL, Kanke (Ranchi).

The uplands of Chotanagpur have acidic red loam soils. These soils are poor in nitrogen, phosphate and organic matter. Even though crop production by the addition of lime and fertilizers has increased the organic matter content of the soils remains almost unaltered in these soils. Addition of organic matter as compost and green manure has also been ineffective in raising the organic matter status of the soil. The degree of humification is very low. With a view to accelerating humification, experiments were conducted during the years 1959-61 with compost and green manure with and without concentrated nitrogenous organic materials. This changed the C/N ratio of the organic matter added to the soil. α-humus was determined as an index of humification on the treated soils every six months. As the experiment was laid out in the field, crops were grown every year. α-humus data indicated clearly that by narrowing down the C/N ratio of the organic matter added, the humification was considerably increased. It was, however, observed that during summer there is a drop in the α-humus content while in winter there is a distinct rise. This indicates that α-humus is not quite stable and is subject to seasonal fluctuations. Nevertheless, the interesting fact that emanated out of this study is that whether in summer or in winter the degree of humification is always higher when the organic matter added is of narrower C/N ratio.

16. Soil Moisture correlation with Microflora and Nitrogen transformations in Jute Soil.

A. B. ROY and A. K. MANDAL, Barrackpore.

The influence of seasonal variations profoundly affects the moisture content in the soil and consequently changes the microbial activities. Nitrogen transformations again largely depend on the microbial activities. In the present investigation nitrogen transformations in jute soil and how these vary with the moisture content have been studied.

The fluctuations of moisture content affected the soil microflora. Greater number of fungi was observed in the drier condition of the soil which was much more evident when the soil was incorporated with carbohydrates. The moisture correlation was found to be negative with the fungal growth. But the bacterial count showed a positive significant correlation with the moisture content. The effects of nitrification on varying moisture levels were significant at 5 percent level when not associated with carbohydrates. Nitrification was completely inhibited on addition of energy material in this short incubation study with jute soil.

The increase of Azotobacter, although was not so much marked below 10 percent moisture, the correlation was obtained at all moisture levels. The correlation with Azotobacter and nitrogen fixation was found to be significant at 5 percent level only when energy material was added.

17. Study of the effect of chlorinated insecticides on nitrification on alluvial soil of Gwalior.

HARPAL SINGH and V. S. MEHLA, Gwalior.

It is believed that the increased use of the most important chlorinated pesticides may have some cumulative toxicity of chloride or hydrogen chloride in cases where dehydrochlorination takes place as well as other toxic properties of hydrocarbons and may have harmful effects on soil microorganisms particularly on those which are responsible for converting ammonical nitrogen to nitrate nitrogen and thus retard the formation of available nitrogen which is the governing factor for the yields per acre. To note this effect recommended doses of different pesticides like DDT, BHC, Lindane (Genma BHC), Aldrin, Toxaphane and Chlordane were applied in the 4 lbs. soil and that was incubated at a definite temperature of 36°C keeping 15 per cent moisture level throughout the investigation.

Under the doses applied it is observed that pesticide application does not have any appreciable effect on nitrification. However, pesticides like Lindane, Aldrin and Chlordane had some retarding effect in the beginning which was not observed later. DDT behaved more or less like control with maximum nitrification on 45th day whereas in the case of BHC, Lindane and Toxaphane it reached maximum on 60th day. In case of Aldrin and chlordane it was further delayed and maximum nitrification is observed upto 76th day. Since there is no marked influence of these pesticides except of Aldrin and chlordane where there is slow action only in the beginning it reduces the possibility of the concept of the effect of chlorine or HCl on nitrifying bacteria. This is also in support of the previous work of Sen and Singh (1961) where no effect was observed on the total biological population of the soil when studied under different treatments of pesticides.

18. The effect of continuous application of trace elements upon nitrogen fixation in rhizosphere and non-rhizosphere soils of jute crop.

A. B. ROY, H. PAL and M. K. MUKHERJEE, Barrackpore.

The uncropped soils after 5 years of cultivation with jute crop added with different doses of trace elements on acre basis viz. Borax @ 2·5 lbs, Copper sulphate @ 5·0 lbs., Zinc sulphate @ 2·5 lbs. and @ 7·5 lbs., Ammonium Molybdate @ 2·0 lbs. and 5·0 lbs, Cobalt nitrate @ 2·0 lbs, Manganese sulphate @ 2·5 lbs and 7·5 lbs show increased efficiency of nitrogen fixation. The nitrogen fixing efficiency generally increases during the cropping period with or without the application of trace elements. The effeffcts of rhizosphere and non-rhizosphere soils show certain increase in nitrogen fixation nearing 45 days of crop maturity just prior to the application of trace elements.

It has been observed that general depression of nitrogen fixation occurs near about 60 days. But the tendency to show slight increase in nitrogen fixation has been marked at 75 days of crop growth. After 75 days it begins to decline and makes no appreciable difference between rhizosphere and non-rhizosphere nitrogen fixation till the harvesting stage of the crop.

Further addition of trace elements produces no effect in rhizospheric nitrogen fixation. The efficiency falls more or less in rhizosphere than in non-rhizosphere soils.

19. Decomposition of hemicelluloses during fungal retting of *Hibiscus cannabinus* and *H. sabdariffa.*

G. HALDER, A. K. KUNDU and A. K. MANDAL, Barrackpore.

The separation of fibre bundles in the stem of fibre yielding plant is effected by the breaking down of the soft cells surrounding them during retting. It is generally considered that the separation is due to the decomposition of pectic substances present in the walls of such cells. It is, however, found that besides pectin, hemicelluloses are also decomposed during retting of hemp, jute, ramie and Agave sisalana. An investigation was, therefore, undertaken to study whether hemicelluloses are decomposed during retting of *H. cannabinus* and *H. sabdariffa.*

Pectin, Ca-pectate and hemicelluloses isolated from them did not contain any free sugars. Glucose was present in the ribbons of *cannabinus* and glucose and galactose were present in *sabdariffa* in free state. The hydrolysates of hemicelluloses and pectin yielded pentoses and hexoses which were not present in the ribbons in free state except glucose and galactose. Hydrolysates of Ca-pectate yielded only galacturonic acid. The presence of pentoses and hexoses in the pectin hydrolysate is considered due to the admixture of hemicelluloses with pectin. Pentoses and hexoses which were not present in the ribbons in free state were also found in the retting system of *cannabinus* and *sabdariffa* during retting with *A. niger* and penicillium *sp.* Moreover, these sugars were identical with the sugars obtained by the hydrolysis of hemicelluloses isolated from *cannabinus* and *sabdariffa.* This obviously shows that hemicelluloses present in the plant are decomposed into component sugars by fungi during retting.

20. Reclamation of salt lake in West Bengal.

K. SEN GUPTA, Kalyani.

The salt lake which lies to the east of Calcutta is a vast tract of water-logged swamp covering nearly an area of 30 square miles. This low-lying area was originally formed from the spilled area of the once mighty tidal river Bidyadhari. Gradually the river silted up and the whole area has become a swamp.

Continuous inundation in the past by tidal water from Bidyadhari river and poor drainage due to silting up of the river subsequently have made the soil saline inspite of the fact that rainfall in this area is between 60″ to 75″ per annum. The salinity is of the order of 0·7 per cent and pH varies between 7·2 and 8·4.

Recently, an experiment to reclaim the saline soil was undertaken on a Pilot Polder. The salts were removed from the soil by continuous leaching during the rainy season and the leachate was pumped out. The water table was kept below root zone by pumping. During rabi season irrigation was provided to keep the salt below the root zone.

Crops have been raised both in *kharif* and *rabi* seasons during the years 1958-59, 1959-60 and 1960-61. Yield of Aus paddy and *olitorious* jute in *kharif* season have gone up from 13 mds. 11 srs. and 11 mds. 36 srs. respectively in the year 1958-59 to 18 mds. 20 srs. and 26 mds. 10 srs. respectively in the year 1960-61. Yields of Cabbage and Wheat in *rabi* season have gone up from 144 mds. and 12 mds. 20 srs. respectively in 1958-59 to 204 mds. and 16 mds. respectively.

There is thus a gradual improvement of soil condition which is reflected in the gradual higher yields obtained.

21. Effect of Bentonite additions on the base exchange capacity and water holding capacity of some West Bengal soils.

B. CHATTERJEE, Howrah.

Increase or otherwise in the base exchange capacity and water holding capacity of some West Bengal soils on the addition of increasing doses of a sample of Bentonite ($<$ 20 mesh) has been measured. The base exchange capacities of the soils have been found to increase with increasing addition of Bentonite but the water holding capacities of these soils do not appear to show any appreciable increase on the addition of Bentonite upto 2 per cent under the conditions of the experiment. A decrease in the water holding capacity of the soils has been observed for addition of small doses of Bentonite. Further work on this topic is in progress.

22. Cationic and anionic relationships in different types of tobacco grown in *goradu* soil.

K. A. PATEL and B .V. MEHTA, Anand.

Besides some of the common physiological functions like the buffering of the cell sap, neutralization of organic acids and regulation of salt concentration performed by cations and anions present in a plant, they have some specific functions. Compared with most of the other crop plants, tobacco has a higher ash content (16 to 20 p.c.) and the mineral nutrient needs are also very exacting. In order to get an idea of the variation in the cationic and anionic contents of different varieties of tobacco grown on *goradu* soil, 17 varieties of tobacco were analysed for the important mineral nutrients. It is found that there are differences in the contents of individual cations and anions in different varieties of tobacco grown on *goradu* soil, but they are particularly wide in case of calcium, nitrogen, chloride and silicon. The cationic and anionic sums also show a wide variation. But there is a significant positive correlation between the sum of cations and the sum of anions.

23. Soil Survey of Bundi District in Rajasthan State.

V. C. SHARMA and K. M. MEHTA, Udaipur.

Soil survey of 2000 sq. mile area of Bundi district in south-east of Rajasthan state was carried out. Survey of India topo sheet of scale 1″ to a mile were used as base maps. The climate is semi-arid with moderate to severe summer and severe winter. The rainfall is about 28″. The soils of the district fall into two major physiographic regions, the hill region and plain region with scattered out crops and undulating areas. The soils have been divided into thirteen different series. The series has several types and eroded phase and calcareous variant. Morphological, physical and chemical characteristics of five major series in the area have been described. Soil maps have been prepared. This classification will help in planning simple experiments on cultivators' fields with a view to have better and intensive use of varieties, fertiliser and other cropping practices for different soil types.

24. Chemical composition and nutritive value of green Bharra (*Saccharum munj*) grass cut and dried into hay in (i) August and (ii) September.

G. C. LAL SAXENA, M. M. JAYAL and V. MAHADEVAN, Izatnagar.

The percentage chemical composition of August and September cuts of *bharra* grass hay, on oven dry basis (100°C) is given below :—

Bharra grass :	C.P.	E.E.	C.F.	N.F.E.	Ash.	Calcium (Ca)	Phosphorus (P)	Magnesium (Mg)
1—August cut hay	6·08	1·82	37·15	48·31	6·63	0·35	0·19	0·32
2—Sept. cut hay	4·38	1·34	45·46	42·65	6·17	0·27	0·17	0·26

Feeding trials were conducted on *kumaoni* bullocks, fed as a sole feed. The hays were unpalatable to bullocks. Mixed with wheat bran supplying the digestible crude protein requirements of the animals, limited quantities of chaffed *bharra* hays were consumed comfortably. The remaining dry matter requirements were met by feeding wheat *bhoosa ad libitum.*

The animals consumed an average of 0·61 kg. of the August cut hay and 0·47 kg. of the September cut hay on dry basis per 100 kg. body weight per day, the dry matter ingestion being 1·45 kg. and 1·46 kg. respectively. Thus August cut hay constituted 41·85% of the dry matter consumption of the animals as against 32·19% of the September cut hay.

The average digestibility coefficients for the two hays are given below :

	C.P.	E.E.	C.F.	N.F.E.
August cut hay	40·31	51·73	45·19	30·06
September cut hay	nil	49·16	32·67	25·93

The percentage digestible crude protein and total digestible nutrients values on dry basis for the two hays are given below:

	D.C.P.	T.D.N.
August cut hay	2·45	35·90
September cut hay	nil	27·39

It may be concluded that August cut hay is superior to September cut hay in nutritive value. In energy value as represented by T.D.N. both the hays are poor.

25. Nutritive value of *Moong (Phaseolus mungo) bhoosa.*

P. S. GUPTA, M. M. JAYAL and V. MAHADEVAN, Izatnagar.

The percentage chemical composition of *moong bhoosa* on oven dry basis (100°C) was: crude protein 11·55, ether extract 1·76, crude fibre 32·15, nitrogen free extract 43·93, calcium 1·76 and phosphorus, 0·18.

Six *hariana* calves fed with *moong bhoosa ad libitum* consumed an average of 2·07 kg. of bhoosa on dry basis, per 100 kg. body weight per day which is indicative of its satisfactory palatability.

The average digestibility coefficients for crude proteins, ether extract crude fibre and nitrogen-free extract were 44·74, 13·48, 42·84 and 45·69 respectively. The percentage digestible crude protein and total digestible nutrients, on dry basis, were 5·17 and 39·55 respectively. All the experimental calves displayed positive retention for nitrogen, calcium and phosphorus.

26. Palatability and Nutritive value of August-cut *bharra (Saccharum munj)* grass hay when fed in combination with green berseem.

G. C. LAL SAXENA, M. M. JAYAL and V. MAHADEVAN, Izatnagar.

Finely chaffed *bharra* hay was thoroughly mixed with finely chaffed green berseem in the ratio of 2 : 5. The mixture was fed *ad lib.* to six *kumaoni* bullocks. The feeding trial extended over 40 days, the last 10 days constituting the collection period. The animals consumed on an average 1·53 kg. of the combined ration, on dry basis, per 100 kg. body weight per day, the contribution from *bharra* hay being 69·28% of total dry matter. When mixed with wheat bran and wheat *bhoosa* the consumption of *bharra* hay on dry matter basis was only 41·55% of the total dry matter. The data show that green berseem is a far superior supplemental feed to wheat bran in enhancing the palatability of the hay.

The average digestibility coefficients for C.P., E.E., C.F. and N.F.E. of *bharra* hay were 40·05, 47·27, 42·23 and 36·31 respectively.

The D.C.P. and T.D.N. values in kg. per 100 kg. of dry matter of the hay were 2·44 and 37·75 respectively.

The experimental animals displayed positive balances for nitrogen, calcium, phosphorus and magnesium and maintained their weights throughout the feeding regime.

27. Nutritive value of *jowar (Andropogon sorghum)* green, hay and silage.

B. M. PATEL, P. C. SHUKLA and V. V. MISTRY, Anand.

Jowar fodder is fed in green condition. But, if in excess it is stored as hay or silage. Composition and digestibilities of the three forms were studied to evaluate their nutritive values. Results of composition, digestible nutrients and mineral and nitrogen balances have been discussed. Storing as silage showed an increase in ether extract and ash content and decrease in crude fibre content. Silica content was found to be higher in silage and hay than in green form. Digestibility coefficients for green *jowar* were higher for all the constituents except crude fibre. Ether extract and N.F.E. were more digestible in silage than in hay while crude fibre digestibility was higher in hay than in silage. The T.D.N. and D.C.P. supplied by 100 lb. (on dry matter basis) of green *jowar,* hay and silage were 64·5, 4·7; 57·8, 2·5; and 54·9 and 2·3 respectively. Green *jowar* showed positive balance for calcium, phosphorus and nitrogen while hay was in positive balance for phosphorus only and *jowar* silage in positive balance for calcium and nitrogen. Moreover the carotene content in the green, hay and silage forms were found to be 2760, 53, and 850 $\mu/100^{g}$ D.M. respectively.

Twelve pounds (on dry matter basis) of green *jowar* supply enough nutrients to maintain an animal weighing 800 lbs. while the same amount of either hay or silage would supply enough T.D.N. only and should be supplemented with leguminous fodder to make up the protein requirement.

ANIMAL HUSBANDRY

28. Comparative economics of feeding concentrate mixture and cottonseeds alone to the milch buffaloes.

B. M. PATEL, V. V. MISTRY and P. C. SHUKLA, Anand.

An experiment was conducted on two equal groups of twelve *surti* buffaloes for comparing the cost of feeding concentrate with that of feeding cottonseeds alone taking into consideration the quantity and quality of milk produced. The concentrate mixture consisted of 15% guar meal, 20% each of G. N. cake, cottonseeds, rice polish and maize bran, and 5% *bajri* husks, along with common salt and bone meal at the rate of 2 and 1 per cent respectively.

The results indicated that the cost of feeding concentrate mixture per buffalo per month amounts to Rs. 20/- with production of 258 lb. milk containing 20·3 lb. fat fetching Rs. 58/- whereas in the case of the cottonseed feeding the corresponding values were Rs. 32·70, 275 lb., 21·7 lb. and Rs. 62/-. Thus the net advantage in feeding concentrate mixture as against cottenseed feeding is Rs. 8·70 per month per buffalo, which would mean an annual saving of about 30 million rupees in Kaira District alone. No difference was observed in fat, T.S., S.N.F., CaO and P_2O_5 contents in milk of the two groups.

29. India's cows and plough cattle and their inter-relation with work and milk production.

I. CHATTERJEE, Calcutta.

India has 53·9% male oxen and 27·75% male buffaloes out of 154·68 million cattle and 43·28 million buffaloes (1951 census). The proportion of latter is contrary to the usual tendency in all species for an even sex ratio.

In 15 pre-reorganised states the male oxen vary between 46% and 54%, one has 40·7% and four 55% to 62%. The proportion of buffalo male varies from 5·73%

in Delhi to 37% in Bihar. Only in Assam, M.P., Orissa, Trav. Cochin and West Bengal it is between 47% and 69%. In other age groups also the variation amongst buffalo males is erratic but much less seen among oxen.

In ten out of 21 states viz., Assam, Bihar, M.P., Orissa, West Bengal, Jammu and Kashmir, Rajasthan, Trav. Cochin, Himachal Pradesh and "Other areas" more cow milk than buffalo milk is produced. In Madhya Bharat and Mysore both milk are evenly divided. In the remaining 9 States more buffalo milk than cow milk is produced.

In seven states the working male oxen constitute less than 1 per cow, in two about 1, in seven 1·05 to 1·2, in another three ,1·33 to 1·38, in Bombay 1·51, in U.P. 1·87 and in India 1·23. The proportion is such that even a lesser number of cow can produce the same or even more number of males. If so, our belief that cows are mainly maintained for their males and so their milk yield is low needs modification.

The real cause of low milk yield is related as much with large number of cows as with the high proportion of dry ones. In 15 out of 21 states the dry cows preponderate, and are 3·14 times of wet ones in Hyderabad, 2·3 times in Orissa and Mysore, 2 times to 1·73 times in Madhya Bharat, Madras, Bihar, Trav. Cochin, Vindhya Pradesh and Jammu and Kashmir. In India it is 1·5 times. Only in Punjab, Delhi, Saurastra and PEPSU amongst better situated states and Assam (low yield area) there are more wet than dry cows. Such a situation seriously hampers economic milk production, and can hardly be congenial even for production of efficient bullocks.

If a phased elimination of dry cows at the rate of 7% to 15% in three states, 18 to 39% in ten states and 52% in Hyderabad be carried out it will bring 20% reduction in India with corresponding reduction in maintenance cost and producing cost of milk. This is possible without slaughter.

30. Studies on carotene content in some fodders and tree leaves.

B. M. PATEL, P. C. SHUKLA and V. V. MISTRY, Anand.

Carotene content in various fresh and stored fodders and tree leaves at different stages of growth has been reported. The results indicated that due to storage of about 2—3 months, there was a loss of about 90 per cent carotene content in fodders, while it was somewhat low in tree leaves. It was also observed that *bajri* and *jowar* fodders containing about 350 and 120 rg. carotene per gram of dry matter respectively lost practically all their carotene content at 12 weeks' growth while maize which was low initially lost its carotene content earlier at about 10 weeks' growth.

Among tree leaves, *samadi* (*Prosopis spicigera*) and tamarind contained about 235 rg. and *neem* (*Melia azadirachta*) and *rayan* (*Mimusops hevandra*) contained only about 170 rg. carotene per gram of dry matter. However, castor contained very high amount (369 rg./g.). It was observed that these tree leaves are slightly richer in carotene content during winter. It is estimated that feeding of only about 4 lb. of fresh tree leaves/day would fulfil daily carotene requirement of a farm animal.

CROP PHYSIOLOGY

31. Further modifications of the technique for determination of chlorophyll stability index (C.S.I.) in relation to studies of drought resistance in rice.

S. K. MAJUMDER and K. S. MURTY, Cuttack.

Chlorophyll stability index (C.S.I.) of plants was earlier reported to be correlated with drought resistance. The technique for estimating C.S.I. is further modified in view of these considerations: (a) chlorophyll stability of varieties can be more effectively tested at higher temperatures, amplifying varietal differences in C.S.I. values; (b) economic use of acetone and reduction in the duration of heat treatment were considered important in view of a large number of varieties under examination.

One gram of fresh leaf, soaked in 25 cc. of water and heated in a water-bath maintained at 65°±1°C. for 1 hour, is extracted with 40 cc. of 80% acetone in a Waring blender for 5 mins. The extract is filtered through no. 1 filter paper and Colorimetric (Klett Photo-electric) reading of the filtrate is taken using no. 66 red filter. Similar reading from an unheated sample is taken as control. The difference between these two readings is designated as C.S.I. of the variety concerned.

Preliminary results indicate that C.S.I. values for known "drought resistant" varieties are consistently lower than those of typically wet-land varieties. Work is now in progress to establish the relationship between the C.S.I. of a particular variety and its final performance in terms of yield under periodic drought conditions.

32. Inducing drought resistance in rice.

B. N. SAHU, Bhubaneswar.

Small amounts of organic extracts appear to stimulate growth to a marked degree. Such substances bring about certain changes in the metabolic process of the plant and thereby increase the drought resistance of the plants. Vitamins and growth hormones like Riboflavin and Nicotinic acids have been attributed to possess certain properteis. *Convolvulus pescaprae* (*Ipomoea bilobata Forsk, Kansari nai*) is a creeper that grows along the sea face from Balasore southwards and in the sandy beds of the rivers in Orissa. This creeper possesses drought resistance qualities. The creeper must have certain principles either in its roots, stem or leaves in a free moving or in bound form which contribute to its drought resistance capacity.

It was therefore considered to make use of this principle of the creeper in inducing drought resistance in rice crop during its growth.

An experiment was laid out in Agronomy Section of the State Agricultural Research Station, Bhubaneswar, Orissa to study the effect of the Riboflavin and Nicotinic acid along with the different parts of *Convolvulus pescaprae* L. in inducing drought resistance in rice. The experiment was laid out in a split plot design. The interval of irrigation was (1) every day; (2) seventh day and (3) tenth day in the main plot and in the treatments with :—

A. Nicotinic Acid 100 p.p.m.
B. Riboflavin 100 p.p.m.
C. Water suspension of root paste.
D. Water suspension of stem paste.
E. Water suspension of leaf paste of *Convolvulus pescaprea* L.

The strength of Nicotinic Acid and Riboflavin was 100 p.p.m. Pastes of the roots, stems and leaves of *Convolvulus pescaprae* ere suspended in water.

Paddy seeds of N. 136 were soaked in each of the solutions for 24 hours and then were kept under vacuum pressure for one hour. Thereafter the seeds were sown in the seedbed and transplanted in experimental plot when the seedlings were four weeks old.

The experiment was concluded during the summer season as Dalua crop and was replicated twice. Ingredients of *Convolvulus pescaprea* plant were sprayed after 45 days, 60 days and 75 days of the rice plants.

The results of 1958-59 and 1959-60 indicate that Nicotinic Acid induces greater drought resistance capacity than any other treatment. The next to it is water suspension of root pastes of *Convolvulus pescaprea* L (*Ipomoea bilobata*).

33. Effect of different synthetic hormones on growth and development of Jute.

B. K. KAR and J. R. SAHA, Barrackpore.

Corchorus capsularis var. JRC 212 was grown in replicated microplots (5 × 7 ft.) in lines. When the plants were one month old, they were sprayed with Indolyl acetic acid (IAA); Indolyl butyric acid (IBA); Indolyl propionic acid (IPA) and Napthalene acetic acid (NAA) in concentrations of 500 ppm and 1,000 ppm. Spraying was done twice at an interval of ten days.

The treated plants showed prominent curvature of the growing shoot apex which gradually recovered, leaving traces of curvature and in the region of curvature, the radial growth of the stem was appreciably increased. 500 ppm was more effective than 1,000 ppm. The after effects manifested themselves in increased growth rates in height and basal diameter of the stem, in leaf surface, in total green and dry weights.

The percentage increase in fibre yield varied from 7·0% to 41·0% per plant according to the different hormones used. In IPA and NAA treatments, the increase was more than in IAA and IBA.

Stimulation of cambium activity, affecting the formation of xylem and phloem was recorded by estimations of fibre-wedges, fibre-strands per wedge and ultimate fibre cells per strand, which constitute the fibre-complex and determine the yield of fibre.

34. Effect of Foliar Spray of Gibberellic Acid on the Growth of Tomato Plant (*Lycopersicum esculentum L.*)

B. PARIJA and K. C. MAHAPATRA, Bhubaneswar.

The effects of different concentrations of gibberellic acid on the growth of the plants of two tomato varieties were studied. From the observations of growth characters such as height of the plants, number and length of leaves and internodes etc., it is evident that the local variety responded better in the treatment with 50 p.p.m. of the acid whereas the response was greater with a higher concentration (100 p.p.m.) in the American variety—'Oxheart'. The two varieties behave differently in the initiation of flower buds with different concentrations of gibberellic acid. The application of 50 p.p.m. and 100 p.p.m. induced earliness in flowering in the local and the American varieties respectively. The differential growth responses in two cases under the same conditions may be attributed to the difference of the varietal nature of the materials. In both the cases the treated plants exhibited better performance in growth behaviours than the controls. Further work on the ascorbic acid content, carbohydrate fractions and seedlessness is in progress.

35. Effect of Spraying Glucose and Ascorbic Acid on the Survival of Albino Seedlings of *Oryza sativa, L.*

P. C. PARICHA and SITARAM MISRA, Bhubaneswar.

The present investigation was carried out to find out the factors for the viability of homozygous mutants deficient in chlorophyll as also the physiology of gene action. The albino mutants of *Oryza sativa,* L. var. PTB—10 were obtained by irradiating to gamma rays of 20,000 r. The albino mutants were isolated from the other chlorophyll mutants by following the classification of Gustafsson (1940).

In order to prolong the life of the plants the leaves were sprayed with a solution of glucose of 200 p.p.m. alone and in combination with 25 p.p.m. of ascorbic acid.

Spraying with glucose alone did not prove as useful in prolonging the period of survival and increasing the height of the plants as in sprays combined with ascorbic acid, though the former was superior to the control. The plant height and longevity were twice as much in glucose plus ascorbic acid spray when compared against their counterparts in the control. Tiller formation was also observed in the treatment of glucose and ascorbic acid spray which was absent in the other treatments.

From the results so far obtained, in the present experiment, it would not be completely inappropriate to say that glucose as well as ascorbic acid are the two factors, though not the only factors, limiting the growth of the albino plants. The albino plants can suitably be exploited, through detailed studies, to know more about the limiting factors in order to explain the physiology of gene action.

36. Studies on embryo culture of rice.

PRADYOT K. BHANJA, Calcutta.

In recent years, culturing of excised embryos of Japonica rice is being practised in Japan. With a view to standardize the technique for culturing of excised mature embryos of Indian varieties of rice under local conditions, experiments were performed, the results of which are as follows :—

1. Complete excision without injuring the embryo is possible after pre-soaking the seeds in water for 4 to 6 hours.

2. Best growth of the embryos can be obtained only when the medium has a pH between 5·5 and 6·0.

3. The presence of boron as a trace element in the medium is essential for healthy growth of the embryos.

4. Copper and molybdenum are toxic to the excised rice embryos when they are present in the culture medium even in very minute traces.

5. The presence of indoleacetic acid at low concentrations in the culture medium is essential for timely root initiation and the development of a proportionate root system.

6. Yeast extract is a good composite source of vitamins and produces a more balanced growth of the seedlings than the synthetic vitamins do.

7. Autoclaved coconut milk does not significantly promote or inhibit the growth of excised rice embryos.

8. Gibberellic acid, when present in the medium, remarkably stimulates elongation of the internode cells of the seedlings at a particular age.

9. In the seedlings of rice, reared from embryo culture, certain deleterious symptoms appear after transplantation and unlike those of rye or barley, they fail to establish themselves into adult plants when grown in such comparatively simpler medium like that of Gregory and Purvis. But these symptoms can be overcome by using modified White's medium containing IAA and yeast extract.

37. Studies on the growth of isolated tissues of rice 1. Effect of iron and Gibberellic acid on light inactivated growth process.

T. M. DAS and A. SHOME, Calcutta.

From 72 hours germinated seedlings of rice var. *Chinsurah Boro* 1, 8 mm. root-tip and 5 mm. coleoptile segments were cut off and inoculated in a 100 ml. beaker containing 50 ml. of modified Burstrom nutrient solution (1960). The experiment was carried out under controlled light and and temperature conditions.

It was observed that elongation of root cells was always accelerated in the dark with iron, but in the absence of iron growth was significantly greater in light. The optimum requirement of $FeCl_3$ for growth of root-tip and coleoptile segment is the same (10^{-5}M). In decapitated coleoptile segments a lower concentration of $FeCl_3$ ($10^{-6.5}$M) was found favourable for growth.

Root growth was stimulated with GA (0·01 mg/L) but at higher concentrations, GA slightly inhibits the root growth. With lower concentration the maximum rate of growth was attained during the early period of the experiment, but this was reversed at higher concentration. GA reverses the iron-induced inhibition in light. Higher concentration of GA (0·1 mg/L) has been found to accelerate growth of intact and detipped coleoptile. In the roots by the dual action of GA and iron the growth was lessened than by GA alone. However, in the coleoptile segment neither decreased nor increased growth was noticed.

38. Seasonal variations in dormancy and viability of paddy seeds.

B. N. GHOSH, Chinsurah.

Three varieties of aus (summer) : Kele, Jhanji—34 and Satika, three varieties of aman (winter) : Latisail, Badkalamkati—65 and Rupsail and four varieties of boro (spring) : Chinsurah boro—I, Chinsurah boro—2, Tepa—I and Tepa—II, were studied both in the boro (dry) and kharif (wet) seasons to determine seasonal variations in dormancy and viability. The seeds were germinated on moist blotting paper in petri-dishes at room temperature, five petri-dishes being used as replications for each variety. The first counting of germination was recorded fifteen days after harvest and then monthly records noted up to one year.

The germination percentage in aus, aman and boro is found higher (more than 90) in the boro season than in kharif, indicating no dormancy in these varieties when collected during the boro season. In boro varieties, however, the seed when collected in kharif shows no dormant period, the germination percentage being more than 90; but in aus and aman, there is dormancy of varying degrees. In aus varieties there is slight dormancy, the percentage germination fifteen days after harvest in Kele, Jhanji—34 and Satika is 64·1, 59·3 and 59·1, respectively; whereas in aman varieties, there is a definite dormant period in Latisail and Rupsail as there is no germination of seeds fifteen and forty-five days after harvest at room temperature. But when the seeds of these two varieties are germinated at a higher temperature in a wide-mouthed Thermos flask washed with boiling water, the germination percentage fifteen and forty-five days after harvest is 32·2 and 66·2 in Latisail, and 27·8 and 67·8 in Rupsail, respectively. In Badkalamkati—65 slight dormant period is noticed as the germination percentage is 60·8, fifteen days after harvest.

As regards viability, the seed of aus variety loses viability within a year when collected during the boro season, but no such loss is recorded in the seed collected during kharif. The viability of the seed of aman and boro varieties when collected in the boro and kharif seasons remains intact throughout the year except in the vo boro varieties, Tepa—I and Tepa—II, where deterioration in germination of e seeds collected during the boro season is noticeable 255 days after harvest.

From the result of the above study, it seems that the seasonal effect on dor-ancy and viability of paddy seeds is of varietal nature, since the seeds of different arieties behave differently. Further studies are in progress.

9. Analysis of the effect of very short exposure to light on growth of mosocotyl and coleoptile of rice.

T. M. DAS and J. M. CHOUDHURI, Calcutta.

In this experiment seedlings of rice var. *Rupsail* were cultured for 120 hours hen they were periodically exposed to light, durations of which were—(1) 1/2 econd, (2) 2 seconds, (3) 15 seconds, (4) 30 seconds, (5) 45 seconds, and (6) 1 inute at every 24 hours of darkness. Control sets of continuous darkness and con-inuous light were also maintained. The intensity of light of the experiment was 25 f.c. and temperature was 30·3°C.

From the result of the experiment it is quite apparent that the most sensitive art of the embryo to light was the mesocotyl. The 100% inhibition of growth of esocotyl by light was recorded at the minimum periodic exposure of one minute. he exposure to light as brief as 1/2 second also possessed inhibitory action on the rowth of mesocotyl. Growth of the coleoptile was significantly inhibited by light t the minimum periodic exposure of 15 seconds. In the case of second leaf, third eaf and root no significant differences were obtained between different treatments vith short exposure to light.

40. Studies in Photoperiodism. I. Effect of photoperiods on growth and reproduction of a few perennial species of plants.

J. K. CHOUDHURY, Allahabad.

Photoperiodic behaviour of perennial plants are known to a lesser extent com-ared to that of crop plants and other annuals. This information in respect of the ormer group may, however, be of great help in breeding, shortening of juvenile eriods, plant introduction etc. with consequent advantage to horticulture, forestry nd silviculture. To gather such information and also to evolve a working tech-ique, a few shrubby and tree species are being raised in different day lengths and preliminary account of this work is incorporated hereunder in respect of those which have already shown some results.

The species reported here are *Ricinus communis* Linn., *Datura innoxia* Mill. nd *Lochnera rosea* (L) Reichb. They were raised in big pots and kept in Long 16 hours), Short (6 hours) and Normal days (about 12 hours) when they, respectively, vere 25, 41 and 40 days old from germination. All the plants were kept in the open during the day, but at specified hours short and long day plants were removed to two separate rooms to continue with their respective treatments.

Results show that long days encouraged vegetation growth and also earliness in flowering by 18, 21 and 9 days in *D. innoxia*, *R. communis* and *L. rosea* after a reatment period, respectively, of 26, 48 and 49 days during January to March, 1961. lower buds in short day plants appeared 8 days after and 2 days before those in ormal day ones in *L. rosea* and *D. innoxia*. Short day *R. communis* has not lowered so far. Relationship between day lengths and height, basal diameter, umber of internodes and of leaves, internodal length etc. of the plants were noted. The work is still in progress.

41. Experiment on paddy in relation to musical sound.

G. PURUSHOTHAMAN, Pondicherry.

Consequent on the researches of Professor T. C. N. Singh on paddy at Sirkali (Madras State), four experiments were laid out in four different villages in the Pondicherry state, on paddy in relation to musical sounds. The control and experimental crops were raised and maintained under identical conditions. Excitation to the crops was dosed by playing recorded music of *"Charukesi"* raga piped on *Nadeswaram* relayed and amplified through a loud-speaker which was placed on the bund of the experimental plots. The crops were stimulated for half-an-hour every day till the crops attained maturity. Periodical observations were made and data were gathered at all stages of the crop growth. The results were subjected to statistical scrutiny.

As a result of the musical stimulus, the "Listening" crops had grown taller and bigger with better developed root system than the control crops, not subjected to stimulation. The former produced longer panicles with greater number of grains in them than the latter. The effect on the reproductive phase of the plant due to the stimulation was noteworthy and remarkable and the grain as well as the straw yields were significantly increased ranging from 22% to 58% and 30% to 62% respectively.

Village Centres.	Yield of grain in lb.		% of increase.
	Control.	Experiment.	
Arasur	2543—12	3737—8	46·9
Sembipalayam	2648—12	3245—0	22·1
Abishegapakkam	2586—00	3855—0	49·0
Porayur	2450—00	3875—0	58·1

CYTOGENETICS AND PLANT BREEDING

42. Observations on natural crossing by insects in Olitorius Jute.

N. DUTT and S. K. GHOSE, Barrackpore.

Present study was undertaken to ascertain the actual agent or agents involved in cross-pollination in olitorius jute and measure the percentages of natural crossing as affected by different agents. For the purpose, JRO—632, a full green type and JRO—620, a light red type were sown in alternate lines, 1′ apart, in a plot of 30′ × 30′, during 1960-61 season. There were altogether 30 lines in the plot, 15 of each type. 30 plants of full green type (JRO—632), 2 from each line, were selected. Of these 30 selections, 15 were screened, one from each line, before the start of flowering, by cages (2′ × 1′ diam.) made of 16-mesh wire-netting. Lower end of each cage was connected with a cloth cylinder of 1′ in length for tying with the plants. 15 other selections were kept open and were unscreened. Progenies from each of these selected plants, screened or open, were raised podwise, separately, in the following season, namely, 1961-62 and observations were made on F_1 population on the basis of pigmentation *i.e.* full green or light red type. None of the progenies of the screened JRO—632 contained any pigmented plants and they were all full green type like the recessive mother. Natural crossing in these was nil. It is, therefore, suspected that wind does not play any role as an agent for cross llination in jute as the meshes of the wire-net cages were sufficiently big to low entry of pollen grains.

In the unscreened plants, natural cross was 5·26% on average, the range being 90% to 14·35%, during 1960-61. Flowers were visited freely by various insect ecies and crosses were effected. Because wind plays a negative role as an agent cross-pollination in jute, natural cross percentage as obtained in unscreened ants, therefore, gives the estimate of cross-pollination by insects.

3. Rate of pollen tube growth in *Corchorus aestuans* Linn. (= *C. acutangulus* Lamk), *C. siliquosus* Linn. and *C. sidoides* F. muell, wild jute species.

R. M. DATTA and B. S. PANDA, Calcutta.

In all these three jute species maximum growth takes place in the first hour. ifferent sugars are suitable for different species in different concentrations.

Pollen tubes do not grow beyond 3 hours in *C. sidoides*, whereas they grow r 4—4½ hours in *C. aestuans* and *C. siliquosus*, a natural polyploid.

Detailed discussion is given in the paper with curves etc.

4. Pollen grain morphology of *Corchorus asplenifolius* Burch., a wild jute of Africa.

R. M. DATTA and B. S. PANDA, Calcutta.

Pollen grains are oblate tricolpate. Tetracolpate grains have been found. The L—pattern was also observed, similar to that found in other species of *Corchorus*. xine is reticulately thickened; the thickenings appear as radial bars in sectional iew. Three germ pores are found usually, one each in the middle of a fusiform erminal furrow. Intine does not protrude through the germ pore in ungerminated ollen.

5. Effects of Maleic hydrazide and 2,4-Dichlorophenoxyacetic acid on the pollen tube growth of *Corchorus siliquosus* Linn., a wild jute of America.

R. M. DATTA and B. S. PANDA, Calcutta.

Pollens were cultured in sucrose and lactose media with different concentra- ons of MH and 2, 4-D.

The growth of pollen tubes is more in all the concentrations of MH used, hereas it is almost always less in different concentrations of 2, 4-D except in case f 7 p.p.m. concentration.

When compared between sucrose and lactose with MH, it is clear that there s very much increase in the former.

Different bar diagrams illustrate the effects on growth of pollen tube.

46. Karyotypes of 4n *Corchorus olitorius* L., strain C. G., 2n × 4n population of *Corchorus olitorius* L., strain C. G., 4n *Corchorus capsularis* L., strain D154 and *C. fascicularis* Lamk., cultivated jute species and its wild ally.

R. M. DATTA and B. S. PANDA, Calcutta.

Roots, measuring 5—6 mm. in length, were pretreated in fresh Aesculin solu- ion and were kept for not less than 3 hours at a temperature of 8—9°C. After pretreatment they were fixed in Acetic-alcohol (1 :2) for 45 minutes to an hou Then they were squashed in aceto-orcein after hydrolysis.

Chromosome morphological studies reveal differences between different speci of *Corchorus*. 4n *C. olitorius* (an autotetraploid) has its karyotype—A_2 B_4 C_4 D_3 E 4n *C. capsularis* (an autotetraploid)—A B_5 C_2 D_6 and diploid *C. fascicularis* h A_2 BC D_3.

2n × 4n (3n) *C. olitorius* (an autotriploid) shows variations in chromosome numbers in its tissues, ranging from 12—56, maximum frequency being 28 in the cel studied so far.

Karyotype of *C. fascicularis* is reported for the first time. Those of 4n material show variations, when compared to the respective 2n materials. (cf. Sharma an Roy, 1958).

Along with polyploidy, reduction in size of the chromosomes is noted.

47. Effect of auxins and antiauxins on the rate of pollen tube growth of *Crotalaria juncea* Linn.

R. M. DATTA and P. K. BISWAS, Calcutta.

The average stylar length of *Crotalaria juncea* Linn is about 16000 microns which means that the tube length obtained *in vitro* with or without the three chemicals used (3—Indole acetic acid, Napthoxy acetic acid and Maleic hydrazide) falls much short of the minimum that would be acutely required to affect fertilization.

From data available it is evident that at least these three chemicals—two auxins and the other antiauxin—individually are not suitable for pollen tube elongation for the purpose of hybridization work.

48. Somatic chromosome numbers and Karyotypes in some species of the genus *Crotalaria.*

R. M. DATTA and P. K. BISWAS, Calcutta.

Five types of chromosome pairs were noted in both the species, but the number of pair or pairs of chromosomes included in each type varied in the two species.

Length of the chromosomes in *C. verrucosa* was relativtly longer than that of *C. saltiana* (=*C. striata*).

Both the species have only one pair of secondary constricted chromosomes.

In *C. striata* out of the 9 constrictions 4 are median, 4 are submedian and one subterminal in position, whereas in *C. verrucosa* 3 are medium, 4 submedium and 2 subterminal in position.

Somatic chromosome number 2n = 16 for *C. ferrugiana* is reported for the first time.

49. Meiotic studies and chiasma frequencies in some *Crotalaria* species.

R. M. DATTA and P. K. BISWAS, Calcutta.

Meiotic studies show some irregularities. Hypo- and hyperploid cells occur as in other species of *Crotalaria* (Datta, 1933; Atchison, 1955 and Roy and Sinha, 1958). Unreduced gametes found in *Crotalaria usaramoensis*, though rare, is a new record. These irregularities reflect on the pollen fertility percentage.

A comparative study of chiasma frequency in these three species shows that ere combination of characters is maximum in the wild species (*C. usaramoensis*, ·3 average chiasma per bivalent) and between the other two species, namely *C. ncca* (cultivated) and *C. verrucosa* (wild), the former shows more recombination characters (1·25 as compared to 1·23 of the latter).

HORTICULTURE

). Effect of hybridization in mango on physio-chemical characteristics of fruits.

P. C. MALLIK, T. S. N. SINGH and S. PANDEY, Sabour.

Crosses were made in mango in 1942-44 for combining economic characters hich might lead to the commercial possibilities of the hybrids. About two dozen edling plants are still growing and many of them have fruited. The description the fruits and their respective qualities have been presented.

In hybrid Langra × Sunder Prasad, the fruits are identical to Langra with flavour id colour of the skin much improved. The yellow-red flesh of Sunder Prasad has me to the hybrids. This fruit will score over the present Langra in their market uality.

In the cross between Bombay and Kalapady, the hybrid has got bigger sized uit with predominant Bombay taste, but ripening one month later. The fruits ave also got good keeping quality like Kalapady.

Total sugar and acid remain intermediate but Vitamin C has in some cases icreased enormously, but still remains lower than the rich parent. Only in mandesheri × Barmasia cross, the Vitamin C has increased very much than both f the parents.

Other characters are intermediate in some, and in others, some characters of ne parent predominate.

.. Effect of a fungicidal wax coating with or without growth regulators on the storage behaviour of mangoes.

. SUBRAMANYAM, N. V. N. MOORTHY, V. B. DALAL and H. C. SRIVASTAVA,
Mysore.

Fully mature green mangoes (Alphonso variety) were dipped in aqueous wax nulsion containing 6 per cent solids and one per cent sodium-ortho-phenyl phenate ith or without growth regulator like maleic hydrazide (MH) or 2, 4-dichlorophenoxy etic acid (2, 4—D). After treatment fruits were dried in a current of hot air a 120°F) and stored at 79°—86°F and R. H. 55—87%. Periodical observations ere made regarding physiological losses in weight; ripening behaviour and hanges in moisture contents, acidity, TSS and ascorbic acid. Percentage wastage as also recorded and all observations were compared with the controls. It was ound that there was considerable delay in ripening in the treated fruits as comared to the control. After twelve days, it was noted that there were higher perentage of green fruits in lots treated with wax emulsion containing 250 p.p.m. IH or 20 p.p.m. 2, 4—D., as compared with waxed or control. However, there as no significant difference between the two treatments containing different growth egulators. The unwaxed fruits ripened within six days as against twelve days for reated fruits. The fungicide used in the above wax emulsion delayed the deveopment of incipient infection, but failed to control decay (due to latent infection) n fruits during ripening.

52. Inhibiting the growth of microbial activities in unprocessed canned fruits by phenomenon of antibiosis and to study its effects on the organoleptic quality of fruits—Part II mango.

P. C. MALLIK, U. P. VERMA, S. PANDEY and S. AHMAD, Sabour.

The use of antibiotic agents namely Terramycin, Aureomycin and Achromycin, in canning of mangoes have proved quite effective in checking completely the growth of any spoilage organisms inside the cans, even though they were not subjected to the processing operations. The cans remained quite fit and its contents edible at the end of one year's storage period. The fruit slices remained firm in texture and original in colour and taste in all non-processed antibiotic treated cans. The vitamin C content had minimum loss in cans treated with 100 ppm Terramycin. Terramycin has been found to be superior to other antibiotics used, with regard to taste, quality and appearance of the fruit slices. The actual quantity of Terramycin present in each can comes to 17·85 mgms in 100 ppm treated cans which is far less an amount when compared to usual therapeutic dose that being two capsules of 250 mgms each per day for a patient.

The cost involved in the use of antibiotics per can is 11 np whereas in cans subjected to usual processing operations followed in Canneries comes to about 20 np per 1 lb. Jam size cans.

Owing to the fact that these antibiotic substances are usually bitter in taste, the maximum dose has to be kept at the lowest level of its effectiveness so that the bitterness added is not perceptible. The 100 ppm has been found to be a safe dose. Further work in order to examine its economic aspects on commercial scales will have to be done.

53. Role of pre-cooling on the storage behaviour of sweet oranges *(Citrus sinensis* Linn., Osbeck).

N. V. N. MOORTHY, N. S. KAPUR and H. C. SRIVASTAVA, Mysore.

Sweet oranges (*Citrus sinensis* (Linn.) Osbeck washed in a solution containing 0·2% sodium orthophenyl phenate, dried in a current of cold air, were pre-cooled at 32-35°F for 16 hours till the temperature at the centre of the fruit reached that of the surroundings. They were then stored at room temperature (75-92°F., R.H. 45-70%) and at 68-70°F and R.H. 75-80%. It has been found that there was a better retention of moisture, ascorbic acid and acidity in the pre-cooled fruits. The physiological losses in weight and wastage were less in the case of treated fruits. The juice recovery of the treated fruits were much higher after 19 days of storage as compared to the controls.

54. Effect of skin coating on storage behaviour of Sathgudi oranges *(Citrus Simensis* Linn., Osbeck).

V. B. DALAL, V. C. MAMADAPUR, N. S. KAPUR and H. C. SRIVASTAVA, Mysore.

Skin coating with aqueous fungicidal wax emulsion extends the storage life of sathgudi oranges and reduces spoilage during refrigerated and common storage. The fruits treated with 6% fungicidal wax emulsion were stored at room temperature (75-92°F) and optimum temperature (42-45°F). Respiration rate, physiological loss in weight, spoilage, total soluble solids, acidity, moisture content, oil content of peel, juice percentage and general acceptability were determined periodically. It is evident from the data that skin coating reduced the physiological loss in weight and rate of respiration considerably thereby imparted the fruit with physio-ogical vitality and an attractive gloss. The spoilage also was very low among the treated fruits. The waxed fruits were fresh even after 3 months storage at low temperature and 4 weeks of storage at room temperature as against 2 months and 10 days respectively of untreated fruits.

55. Studies on the effect of repeated wax coating on the storage behaviour of Coorg oranges (*Citrus reticulata, Blanco*)

V. B. DALAL, H. SUBRAMANYAM and H. C. SRIVASTAVA, Mysore.

Freshly harvested, mature, healthy Coorg oranges were subjected to fungicidal wax coatings by dipping them once, twice, thrice and four times with or without alternate drying, in an aqueous fungicidal wax emulsion containing 4% solids and 1% sodium ortho phenylphenate. Treated and untreated fruits were stored at room temperature (79-86°F; R.H. 55-87%) and their storage behaviour was studied with reference to physiological losses in weight, percentage wastage due to diseases, shrivelling burns due to fungicide, changes in Vitamin C content, titratable acidity, total soluble solids, juice content and respiration rates. Among untreated fruits, shrivelling was very high and therefore they were unmarketable during storage. However, fruits treated more than twice with aqueous fungicidal wax emulsion resulted in damage to the peel of the fruits and poor marketability. Fruits, waxed twice by alternate dipping and drying showed no wastage, minimum shrivelling and gave large number of marketable fruits with excellent gloss and firm texture at the end of 24 days of storage at room temperature. Vitamin C content, juice percentage and titratable acidity declined gradually and total soluble solids increased gradually in waxed fruits. These studies revealed the limitations associated with repeated coatings on Coorg oranges stored at room temperature.

56. Storage behaviour of various products obtained from the skin coated oranges.

N. S. KAPUR, V. C. MAMADAPUR and H. C. SRIVASTAVA, Mysore.

The storage behaviour of the juice, squash and marmalade prepared from reated and untreated sweet oranges stored at low temperature (42-45°F, R.H. 85-90%) and room temperature (75-92°F, R.H. 45-70%) was studied. Sweet oranges were treated with 6% fungicidal wax emulsion containing 0·5% SOPP as a fungicide. The products made out of such variously treated and stored oranges were stored at three temperatures viz., airlock (68-70°F), room temperature (75-92°F), and 98·5°F (37°C) for a detailed study. Products made out of the fresh fruits were compared with those made from treated and untreated fruits stored for different periods at room and low temperature. Brix, acidity, changes in pH, ascorbic acid, optical density at 420 mμ, sugars and colour measurement (Lovibond Tintometer) as well as organoleptic evaluation, were made periodically for squash, juice and marmalade. As a typical case the products from 2 months cold stored, treated and untreated oranges were compared with products from fresh fruits. It was found that the processing of oranges stored under refrigeration for 2 months does not adversely affect the quality of the products. The retention of ascorbic acid was greater in the products made out of the treated fruits.

Similarly products made out of treated oranges cold stored for 3 months and stored for 4 weeks at room temperature compared well with those made from fresh fruits. Thus the processing time for factory could be considerably extended.

57. Role of skin coating on processing of sweet oranges *(Citrus sinensis* Linn. Osbeck).

V. C. MAMADAPUR, N. S. KAPUR and H. C. SRIVASTAVA, Mysore.

Various products like juice, squash and marmalade were prepared from the treated and untreated oranges, stored at room temperature and at optimum low temperature. Brix, ascorbic acid, sugar acid ratio, pH, colour changes and organoleptic evaluations were made for all the products at regular intervals during storage and compared with products from fresh fruits. It was found that treated fruits kept for 4 weeks at room temperature and for 3 months in cold storage, could be processed satisfactorily, whereas the unwaxed fruits stored for more than 3 weeks at room temperature and more than 2 months at low temperature yielded products of poor quality. Further, the spoilage in unwaxed fruits exceeded 10% level after 10 days at room temperature and 2 months at low temperature. Thus the untreated fruits could only be processed economically for 10 days and 2 months against 4 weeks and 3 months in the case of treated fruits stored at room temperature and low temperature respectively.

58. Studies on the effects of manurial treatment with N, K, Ca in combination on canning qualities of Litchi fruits.

P. C. MALLIK, U. P. VERMA, S. PANDEY and S. AHMAD, Sabour.

The effects of N, K, Ca on the canning qualities of fruits applied in combinations, to litchi plants in a separately conducted manurial trial in Horticultural Garden, Sabour, have been studied. There were twelve treatments having three levels of N, two of calcium and one of potash. N in the form of $(NH_4)_2SO_4$, Ca as lime and K as K_2SO_4 were applied. It is found that potash plays a more important role in making the fruits less susceptible to browning during storage, specially in combination with increasing dose of calcium and nitrogen. In absence of potash, nitrogen with calcium appears to have little effect in checking browning of fruits during storage. Increased nitrogen has been found to affect vacuum in the can during storage, and compared to other treatments, the fruits obtained from plants treated with high nitrogen dose reduced the vacuum in the can considerably.

59. Possibility of increasing the life-span of the coconut palm.

T. A. DAVIS, Calcutta.

Unlike the monocarpic palms that complete their life with the first flowering, the coconut palm (*Cocos nucifera*) is capable of growing indefinitely since the origin of its spadices is axillary. However, the latter seldom lives beyond its hundredth year as senelity and the eventual death ordinarily start seizing the palm after its sixtieth year when a steady decline in the yield of nuts is perceivable. Death of several functional roots, difficulties in absorbing and conducting adequate supplies of nutrients across a tall stem and the increasing hazards due to wind are some of the factors contributing towards driving an ageing coconut palm to such a situation. However, a new method of air-layering is described by which the crown of even a very old coconut palm may be separated from the rest of its old stem after inducing fresh roots at a convenient portion of the aerial stem and planted as a "young palm", enabling it to overcome the adversities of old age and live for another long fruitful period.

60. The importance of the aerial roots in *Cocos Nucifera*

T. A. DAVIS, Calcutta.

The roots which emanate from the aerial stem of the coconut, termed aerial roots, are classified into four categories. Of the over 7,000 coconut palms examined under different environments in India, 40% possessed aerial roots and these roots differ from the underground ones in many respects. The palm's capacity to produce aerial roots can be made to serve the scientist and cultivator in several ways. It is possible to rejuvenate even a very old palm by layering and separating its crown for propagation. Also the branches and suckers of certain exceptional palms can be separated and successful clonal propagation effected though in a limited scale.

About 60% of the coconut palms growing under semi-water logged conditions possess aerial roots, which is an adaptation to combat the marshy adverse conditions. This capacity and the good soil binding nature of the roots can help the reclaiming of land from shallow lakes. Many of the manurial trials as well as pot culture experiments with coconut are very difficult to be conducted on account of its massive root system. This difficulty can be appreciably got over by inducing aerial roots by the "box-method" and conducting experiments with the active roots thus induced.

61. Storage of Gamma-irradiated onions.

P. B. MATHUR and N. F. LEWIS, Bombay.

Red Globe onions were irradiated with 6,000 rads of 60 Co/gamma rays at the rate of 1000 rads/minute and stored with appropriate controls at two temperature ranges, viz., room temperature (21-35°C; R.H., 45-90%) and cold storage (15-16°C; R.H., 85-90%). The dose employed was sufficient to prevent the sprouting of onions at both the temperature ranges. There was no difference in the extent of waste between the control and irradiated onions at room temperature. In cold storage, however, no rotting occurred in either of the two lots. After 8 months of cold storage the ascorbic acid content of irradiated onions was only slightly lower than that of the controls. There were no adverse effects on colour, texture, taste and pungency of irradiated onions after 8 months of storage at 15-16°C (R.H., 85-90%).

62. Refrigerated storage behaviour of pre-cooled tomatoes.

H. C. SRIVASTAVA, N. V. N. MOORTHY and N. S. KAPUR, Mysore.

Freshly harvested, fully grown, firm green tomatoes *Lycopersicon esculentum* (Mill) Var. Marglobe) were obtained from a nearby orchard and were pre-cooled at 32-35°F till the internal temperature of the fruits reached the ambient temperature. They were then stored at 42-45°F, 47-50°F, and 52-55°F, the relative humidity at all temperatures being 85-90%. The results were as follows :—

1. The physiological losses in weight were the least in pre-cooled fruits stored at 52-55°F.
2. Ripening and colour development was very uniform at 52-55°F.
3. The wastage was less in the pre-cooled fruits at all the three temperatures as compared to the controls and was the least in the treated fruits stored at 52-55°F.

PLANT PROTECTION

63. Food consumption and adequate bait for Desert Gerbil control.

ISHWAR PRAKASH and C. C. KUMBKARNI, Jodhpur.

Food consumption of *Meriones hurrianae* Jerdon varies from 4 to 5 gms. in 24 hours. The quantity consumed, however, depends on the quality of food. They did not prefer seed diet in captivity. Seeds of 15 plants (*Tecomella undulata, Prosopis spicigera, Prosopis juliflora, Zizyphus numularia, Cenchrus setigerus, Cenchrus ciliaris* etc.) growing in gerbil habitat were tried individually and in mixtures. Trials were made on single gerbil and also in groups. Amongst cereals, wheat and millets were most preferred. Wheat flour was also preferred and can be used as a suitable bait for poisoning the Indian desert gerbil, *Meriones hurrianae.*

64. Microclimate in the burrow of the Indian desert gerbil, *Meriones hurrianae* Jerdon.

ISHWAR PRAKASH and C. G. KUMBKARNI, Jodhpur.

Temperature variations inside the burrow of the Indian desert gerbil, *Meriones hurrianae* were observed with the help of Philips rod thermistors and soil moisture temperature bridge. The thermistor was introduced into the burrow by tying it to the tail of the gerbil. As soon as gerbil rested in the burrow, it got rid of the thermistor by biting the thread off. Thermistors were rarely damaged.

Temperature readings were taken at 50, 100 and 150 cms. horizontally deep inside the burrows. On a hot day the temperature inside the burrow was on an average 6·4°C (±1·0°C) lower than the surface temperature while on a rainy day it was about 4·5°C (±0·7°C) lower than the surface temperature at 50 cms. but the temperature was 3·5°C (±1·0°C) higher at 100 and 150 cms. The temperature variations at 150 cms. fluctuate between 0·5°C (±0·3°C).

65. Toxicity, relative acceptance and lethal dose of certain poisons for the Indian desert gerbil, *Meriones hurrianae* Jerdon.

ISHWAR PRAKASH and C. G. KUMBKARNI, Jodhpur.

Toxicity of various poisons was estimated by oral administration with the help of a hypodermic syringe fitted with a flexible stomach tube. Zinc phosphide is very toxic for *Meriones hurrianae.* An oral dose of 25 mg. in aqueous suspension caused 100% mortality in 3 to 3½ hours. Similarly 50 mg. of Arsenic trioxide killed gerbils in 10-12 hours and 250 mg. of Barium carbonate in 5 to 6 hours.

The relative acceptability (or repellency) of the poisons was measured by the reduction in food intake. There was very little difference in the food intake when Zinc phosphide was administered in concentrations upto 1% of the total bait but at 3%, its acceptability was very low. Arsenic trioxide was unpalatable at 2% concentration but Barium carbonate was readily accepted upto 5% concentration and 10% Barium carbonate was less acceptable. Rodeth and Ratafins were comparatively more acceptable.

The modes of death due to various poisons have been described.

66. "Nuclear radiations in the control of insect pest of storage."

SNEHAMOY CHATTERJI, P. N. SAXENA, G. R. SETHI and G. W. RAHALKAR,
New Delhi.

Nuclear radiations are well known for their harmful effects on the biological tissues. But scientists all over the world have also been vigorously engaged in harnessing them for useful purposes for the benefit of mankind. They have been used as sources for enhancing the yield of agricultural crops and also for the destruction of pests in the field and storage.

In the present communication progress made in the western countries with regard to direct and indirect control of storage pests has been briefly reviewed. It has been suggested that small sources can be effectively used by fractionating the dose instead of a continuous dose from a strong source. It has been observed further by different workers that different insect species differ in their resistance against nuclear radiations. The radiation susceptibility or resistance has been found to vary even with the stage, age and strains in the same species. It has also been pointed out that enough feeding trials would have to be conducted to assess the nutritional quality of the irradiated grains so as to make them acceptable to the consumer.

The property of nuclear radiations to induce sterility in insects has been fully exploited in controlling the screw worm *Callitroga homonivorax* Cqrl. in Curacao islands. This sterile male release technique holds enough promise in the control of storage pests also.

With the installation of 200 curie Cobalt-60 source at the 'gamma garden' of Indian Agricultural Research Institute, New Delhi, work on the use of gamma radiations for the control of insect pests of stored grains has recently been taken up at the Radiotracer laboratory of the Division of Entomology. Experiments are in progress to study the effects of lethal as well as sublethal dosages of gamma radiations on some of the insect pests of stored grains namely, *Trogoderma granarium* Everts., *Tribolium castaneum* Hbst., *Latheticus oryzae* Waterh., *Lasioderma serricorne* Fabr., *Calandra oryzae* Linn. and *Rhizopertha dominica* Fabr. Possibilities will also be explored for the induction of sterility in some of the storage pests, specially those which cannot easily be controlled by conventional methods.

67. Sources of pink bollworm infestation on cotton in Rajasthan.

B. K. SRIVASTAVA and S. P. BHATNAGAR, Jobner.

A study of the hibernating quarters of the Pink Bollworm, *Platyedra gessypiella* Saund. in relation to environmental factors has been made by the authors.

The places where the Pink Bollworm passes the period after the harvest of cotton has been observed as follows :—

(A) In Fields :—

1. Bolls on plants left standing after harvest.
2. Fallen bolls and *Kapas* lying on the surface of the soil.
3. Bolls and *Kapas* lying underground.

(B) In Villages :—

4. Bolls on sticks stored for fuel.
5. *Kapas* and cotton seeds.
   (i) In villager's home.
   (ii) With petty shopkeepers.

(C) In Ginneries :—
  6. *Kapas* and cotton seed.
  7. Low grade cotton and heaps of patti.

(D) In Stores :—
  8. Ginned seed.

These places form the reservoirs of this pest for the infestation of the next cotton crop.

68. Studies on the post-blossom spray of DDT and Malathion for the control of *Idiocerus niveosparsus* (Mango hopper) and the pesticide residues on mangoes.

P. C. GHOSH, K. KRISHNAMURTHY, S. GODAVARIBAI and S. K. MAJUMDER, Mysore.

DDT and malathion in water-dispersible formulations sprayed at 30 mg/sq. ft., of each insecticide, on tree surface, could control the mango hopper. A single spray at the post-blossom stage was adequate for bringing down the population significantly. Effects of the treatment on fruit drop, insect population and on the growth and yield of fruit, were studied. Residues of both DDT and malathion, were estimated progressively from the time of spraying to harvesting. DDT persisted on the leaf surface even up to 120 days, after spraying. But, malathion disappeared within a few days after spraying. Although, there was no significant difference in the size of the fruits from the treated and control trees, there was significant difference on the total number of fruits and total yield. As against the 14 fruits from the control tree, 36 fruits were obtained from the treated tree. There was no evidence of translocation of insecticide to the edible parts of the fruits, as a result of spraying malathion and DDT on the inflorescence.

69. Field sanitation and infestation control in stored grains.

S. K. MAJUMDER, K. KRISHNAMURTHY and S. GODAVARIBAI, Mysore.

Malathion, water-dispersible formulation was sprayed on the ripe grain inflorescence before harvest in different Sorghum plots. With a permissible concentration of 8 ppm on grain at the time of bagging, the persistance and biological efficacy of the chemical in post-harvest storage were studied. Infestations caused by *Calandra oryzae* and *Tribolium castaneum* were controlled in freshly harvested sorghum by the pre-harvest spray treatment on the panicles. Impregnation of gunny bag with Lindane-DDT water-dispersible formulation was found to have residual life for a period of 8 months. Panicles or sorghum treated at the permissible level of 8 ppm of malathion in the pre-harvest period and the threshed grains stored in these insect-proofed gunny bags could keep the grains free from insect infestation. Criteria like kernel damage, viability, fat acidity, water soluble acidity, microbial count, uric acid content and insect population, were assessed. These have indicated the general soundness of the grain stored with the pre-harvest prophylactic treatment.

Paddy, sorghum and pulses showed promise for insect-free storage by the prophylactic spray treatment on grains and insect proofing of receptacles. This technique of storage of grains can be carried out by producers in rural areas where fumigation can hardly be applied without the help of trained personnel.

70. Some prevalent plant diseases in Sikkim-1.

N. C. JOSHI, Calcutta.

The present paper gives a preliminary account of the survey of various diseases occurring on plants, in order to have some idea about their occurrence and distribution, in different parts of Sikkim.

40 fungi, two bacteria and one virus have been recorded in this paper. Among the fungi, eight are Phycomycetes, nine Ascomycetes, ten Basidiomycetes and 13 Deuteromycetes. The virus disease on Cardamom (*Amomum subulatum*) which is commonly called 'Foorkey' disease by the local people in Sikkim and West Bengal is of great economic importance.

71. Effect of sugarcane bud-diffusates on germination of chlamydospores of *Ustilago scitaminea* Syd.

S. K. SAXENA and ABRAR M. KHAN, Aligarh.

The effect of bud diffusates obtained from Co 245, Co 515 and Co 313 varieties of sugarcane was determined on the germination of chlamydospores of *Ustilago scitaminea* Syd. But diffusates stimulated the germination of chlamydospores. No difference was observed in the bud diffusates obtained from these varieties with respect to germination of chlamydospores. Highest germination occurred when diffusates were drawn from 10 buds in 10 ml. distilled water after 12 hours.

72. Studies on Helminthosporium disease of Rice—VI. Nutritional factors and disease expression—Effect of leaching of soil on incidence.

N. K. CHAKRABARTI and S. Y. PADMANABHAN, Cuttack.

An experiment was carried out to find out the reaction of rice plants grown on leached soil to infection by *Helminthosporium Oryzae*. Two resistant (Ch. 13 and BAM. 10) and two susceptible (Benibhog and Latisail) varieties were used in the experiment. The soil was leached at about the boot leaf stage of the varieties. After leaching N, P, K, were added in various combinations. The plants were infected artificially with the spore suspension of *Helminthosporium Oryzae* a week after leaching and addition of nutrients. Observations on leaf infection were recorded after ten days.

It was observed that the infection was higher in the plants grown in leached soil when compared with those grown in unleached soil; secondly, plants which had received addition of N alone after leaching had higher infection than those growing on leached soil without such an addition; plants which had received N & P and P & K, after leaching had lower infection than those which had received N alone.

73. Studies on Helminthosporium disease of rice—VI—Nutritional factors and disease expression—2. Effect of potassium.

S. Y. PADMANABHAN, C. T. ABICHANDANI, N. K. CHAKRABARTI and
S. PATNAIK, Cuttack.

An experiment was carried out to study the development of helminthosporium disease on rice under different levels of potassium. The plants were grown under three levels of K_2O in culture solution, viz., (1) K_2O-O, (2) K_2O 10 p.p.m. and

(3) K_2O 20 p.p.m. T. 141, a variety resistant to helminthosporiose was used. It was observed that the infection was significantly more in the plants which had not received any K_2O in the solution. Within individual plants, the flag leaf had least infection and the intensity of infection in the flag leaf was not different in the three treatments; the infection was significantly higher in the second and third leaf from the top in the no K_2O plants when compared with those plants which had been supplied with 10 p.p.m. and 20 p.p.m. K_2O.

The number of ear-heads, yield of grain and straw were very low in no K_2O treatment, in comparison to the other two treatments. There was 0·26% K_2O in the grain, 0·43% K_2O in the straw in the plants which had not been supplied with K_2O in the culture solution. The K_2O content of plants which had received K_2O in culture solution was comparatively very high (0·44% and 1·58% in grain and straw respectively in plants under 10 p.p.m. K_2O and 0·82% and 2·50% in grain and straw respectively in plants under 20 p.p.m. K_2O).

74. Control of blast disease of rice with fungicides. V. Use of antibiotics for the control.

S. Y. PADMANABHAN, J. VEERARAGHAVAN and K. V. S. R. KAMESWAR ROW, Cuttack.

A field experiment was carried out to find out the efficacy of three antibiotics (viz. Antimycin A, Blastimycin and Central Rice Research Institute antibiotic, obtained from a species of Streptomyces, which was found to inhibit growth of *Piricularia oryzae*) in the control of blast disease of rice. A cupro-mercurial fungicide MCO mercurised copper oxychloride was employed as a standard. The experiment was conducted with the rice variety Co. 13, highly susceptible to blast. The infection was negligible in the sprayed plots, whereas in the control slight foliar infection was present. The sprayed treatments were associated with higher yields than the control.

75. Relative efficiency tests with stickers and spreaders in control of potato late blight in Himachal Pradesh.

S. S. JAIN and P. K. SETH, Solan.

The potato crop in Himachal Pradesh suffers heavy losses from late blight almost every year particularly in areas of high elevations where most of this crop is grown. In such areas, heavy rains cause considerable depletion of the fungicidal deposit on the leaves, when no adhesive is used with the spray mixture. Tests with stickers and spreaders such as Triton B-1956, (8 oz./100 gal.), wheat flour (8 oz./12½ gal.), linseed oil (8 oz./100 gal.), Tenac (1 part to 3 parts of the dry fungicide by weight), and Albolineum (8 oz./100 gal.), used as additions to 0·3% Copper Sandoz were conducted under severe conditions of the disease during the period from 1958 to 1961 at the Regional Potato Development Station, Shilaru (8,500′ m.s.l.) with an annual rainfall of about 70 inches in Mahasu District, to assess their relative efficiency in improving control. Spraying was carried out on variety Up-to-Date at the rate of about 100 gallons per acre four times during July and August at fortnightly intervals. The first application was given in the 1st week of July as a prophylactic measure. The total yield of individual plots was recorded. Good results were obtained with all the stickers and spreaders under test. Triton B-1956 gave the highest yield (161·6 mds./acre), followed by wheat flour (141·8 mds./acre), linseed oil (141·6 mds./acre), Albolineum (141·0 mds./acre) and Tenac (140·5 mds./acre), as compared to the control (110·9 mds./acre), the percentage increase in yield over the control being 45·7, 27·8, 27·6, 27·1 and 26·7, respectively. Amongst the last four stickers and spreaders, which were notably superior to the control, exceeding in yield by 29·6 to 30·9 mds./acre, hardly any significant difference in efficiency was detected. The percentage increase in yield with different stickers and spreaders ranged from 26·7 to 45·0 over the untreated.

76. Studies on the effect of seed-dressings on germination and yield of wheat.

S. S. JAIN and P. K. SETH, Solan.

Field tests with different mercurial and copper seed-dressing such as Agrosan GN, Ceresan, Hexasan, Tillex, Copper carbonate and T.B. 4452b were conducted at the Government Research Station, Dhaula-Kuan (1,800′ m.s.l) in Sirmur District, to study their comparative efficiency in improving germination and yield of the three recommended wheat varieties, viz. NP. 809, NP. 792 and Ridley. The seed was treated with different fungicides at 4 oz./cwt. for 30 minutes, and was sown 10 days after treatment. Germination was recorded 3 weeks after sowing while the yield data was recorded at the time of harvest. The results indicated that with the exception of T.B. 4452b, none of the fungicides had an adverse effect on germination of wheat seed. Agrosan GN, Ceresan, Copper carbonate and Hexasan showed a slight stimulatory effect, while in the case of T.B. 4452b a slight inhibitory effect was observed. Tillex was at par with the control. Higher yields were obtained with seed treated with all the fungicides. Hexasan, Copper carbonate and Tillex proved outstanding in increasing yield, followed by T.B. 4452b. and Agrosan GN. Ceresan, though least efficient, was slightly better than the control. The increase in yield over the control was more than a maund per acre in the case of Hexasan, Copper carbonate and Tillex, the figures being 1·37, 1·33 and 1·07 mds., respectively. The increase in yield with T.B. 4452b, Agrosan GN and Ceresan was relatively small.

77. Comparison of seed-dressings in control of hill bunt *(Tilietia Foetida & T. Caries).*

S. S. JAIN, Solan.

Hill bunt of wheat, caused by *Tilletia foetida* and *T. caries*, is largely prevalent at higher altitudes (5,000′ to 10,000′ m.s.l.) in Himachal Pradesh and causes heavy losses to wheat crop particularly in the drier areas like Kalpa and Pangi. Field tests with different mercurial, copper and sulphur seed-dressings were conducted at Shillaru 8,500′ m.s.l.) in Mahasu District during 1957-58 to 1959-60, to evaluate their comparative efficiency against bunt. Seed of a local wheat variety was artificially inoculated with bunt spores in the ratio of 1 : 192 and thoroughly mixed for about 10 minutes. The inoculated seed was subsequently treated with different fungicides at 4 oz./cwt. for 30 minutes, and was sown 10 days after the treatment. The percentage incidence of the disease was recorded at the time of harvest by counting the total number of healthy and bunted ears. The results indicated that all the fungicides under test were effective in reducing the incidence of bunt. Hexasan, Agrosan GN, Ceresan and Copper carbonate gave an excellent control of the disease, the percentage infection being 0·003, 0·02, 0·02 and 0·14, respectively. Next in efficiency were Tillex and Sulphur dust, both being at par with 1·14% and 1·55% infection, respectively. Lunasan, though least effective, was notably superior to the untreated, and reduced the percentage infection of bunt from 20·81 in the control to 4·3 Sulphur dust, although slightly less effective than other mercury and copper seed-disinfectants tried, was found to be much more economical because of its low cost.

78. Tests of fungicides for control of peach leaf curl *(Taphrina deformans* Tul.).

S. S. JAIN, Solan.

Peach leaf curl, caused by *Taphrina deformans* Tul., is widely distributed in Himachal Pradesh and causes heavy damage to peach crop in cool, humid areas. Field tests were conducted at Bhangrotu (2200′ a.s.l.) during 1957 to 59, and at Mashobra (8000′ a.s.l.) during 1958 and 59 to asses the comparative efficacy of 13 proprietory fungicides with organic, copper and sulphur base, and also to determine whether these could approach in efficiency to that of Bordeaux mixture and lime-sulphur against leaf curl. All the proprietory copper fungicides were used at 3 lb./100 gal. The treatments were applied only once just prior to bud movement, the spray being applied @ ¾ to 1 gallon per tree. The trees were examined for disease incidence towards the end of April or early May. The results indicated that all the fungicides under test appreciably reduced the incidence of leaf curl, but none of them could give an absolute control. At Bhangrotu, lime-sulphur (1 :10) and Bordeaux mixture (5 :5 :50 or 4 :6 :50), on the whole, proved to be most effective, the average number of diseased shoots per tree being 2·05, 2·06 and 2·00, respectively. Among the proprietory copper fungicides, Fytolan and Cupravit were slightly superior to Perenox, Fungi copper, Blitox and Shell copper, the disease incidence being 2·2, 2·9, 3·0, 3·3, 3·4 and 4·03, respectively. Amongst the proprietory wettable sulphurs, Thiovit (0·6%), Spersul (0·6%) and Solbar (1%), which gave equally good control, were slightly superior to Hexamar wettable sulphur (0·6%), the infection being 2·08, 2·08, 2·09 and 2·55 respectively as against 6·32 in the control.

At Mashobra, where leaf curl was more severe, Cupravit and Fytolan provided slightly better control than Blitox, Cupramar, Bordeaux mixture (4 :6 :50) and Shell copper, the infection being 3·5, 5·4, 6·6, 7·7 and 12·2, respectively. No significant differences in efficiency were detected amongst Thiovit, Spersul, lime-sulphur (1 :10) and Solbar, which were superior to Ultra sulphur (0·2%) and Hexamar wettable sulphur, the disease incidence being 5·4, 6·2, 8·1, 8·5, 12·0 and 12·2, respectively. Dithane M-22 (0·2%) did not appear to be as efficient as other fungicides, but was markedly superior to the control, the infection being 22·0 and 35·2, respectively.

79. Studies on cultivation of *Pleurotus Sp.* on paddy straw.

(MISS) ZAKIA BANO and H. C. SRIVASTAVA, Mysore.

Cultivation of *Pleurotus sp.* on various media was tried and it was found that paddy straw soaked in water overnight gave the best results. Jowar stems, hard and soft wood sawdust, paddy hulls and their combination did not give good yield. Low quality cereal grains and pulses were used as a source of nutrient @ 3% of the straw. There was a noticeable increase in yield when red gram and Bengal gram powders were used @ 2 and 3% respectively. Use of 1% superphosphate as a source of phosphorus along with red gram powder gave higher yield. There was no effect on the increase of yield by addition of ammonium sulphate and urea, when used in 0·1 to 0·5% concentration. It was found that as the quantity of straw was increased per bed, there was a noticeable increase in yield. In 400 to 600 gms. of straw per square foot, even three crops were harvested, but on increasing to 800 and 100 gms., the yield decreased.

. Factors Influencing Incidence of Stem-rot in *Corchorus capsularis*

T. GHOSH and A. K. MONDAL, Barrackpore.

It has been suggested that use of ammonium sulphate balanced by requisite iount of potash prevents incidence of stem-rot in *Corchorus capsularis* caused by *icrophomina phaseoli* (Maubl.) Ashby. In a composite trial in grey alluvial .ct the use of ammonium sulphate coupled with potassium chloride failed to event stem-rot. Soil analysis showed that the pH of the sick plot was 5·8 as ainst 6·6 in the unaffected plot. The exchangeable calcium was more in the :ter than in the sick plot. There was no other significant difference. It is, erefore, felt that a basal dressing of lime might reduce incidence of stem-rot jute.

. Comparative Incidence of Diseases in 'Kenaf' and 'Roselle' under field conditions.

T. GHOSH and N. MUKHERJEE, Barrackpore.

The incidence of diseases and damage due to them in Kenaf (*Hibiscus canna- nus*) and Roselle (*H. sabdariffa*) grown under similar conditions in a field trial iow that Kenaf which is a near substitute of jute suffers heavily from brown t due to *Volutella* sp. and anthracnose due to *Colletotrichum hibisci* Poll, while oselle is susceptible to foot and stem rot due to a new strain of *Phytophthora irasitica* Dast.

GENERAL

2. Further Studies of Leaf Morphogenesis in Relation to Important Growth Phases of Rice Plants.

B. SAHA, Barrackpore.

In relation to the initiation of culm elongation and of ear formation in certain addy varieties, the relative lengths of leaf sheath and blade were found to vary. find whether similar relations were general for several rice plants, sown in ferent months throughout the year, the present investigation has been under- cen.

Seeds of *Bhasamanik* (aman), *Ashkata* and *Satika* (aus) and *C.B.I.* (boro) were own in petri dishes and on germination transferred to the big earthen pots in plicate. The aman variety was sown every fifteenth day of the months, from arch to August, 1960, and the other three varieties on almost the same date of ery alternate month all the year round. Most of the various aspects including iration, plant height, total number of leaves, culm elongation, ear formation, irvesting, panicle length and number of grains per ear of the main culm of ie individual groups of sowings were carefully recorded.

Most of the results indicate that the variation of relative lengths of leaf sheath nd blade with respect to the above two growth phases e.g. culm elongation and ar formation, was very evident in nearly all the sets. Besides these, (i) the total umber of leaves of a variety varied with the duration and the time of sowing, ie variability being more in season-bound aman than that in the period-bound aus nd boro paddies; (ii) in almost all the sets of *Bhasamanik*, the mean plastochrone iterval between the development of two successive foliar organs was nearly ten ays, (iii) the extent of hard culm phase was relatively consistant in the individual ariety, but that of the early culm elongation phase occurring before ear initiation as extremely variable and from morphogenetic point of view this latter one is ery important.

SECTION OF PHYSIOLOGY

President :—G. C. Esh, M.Sc., Ph.D. (Ohio), F.N.I.

Abstracts

BLOOD AND CIRCULATION

1. *In Vitro* effect of Hydrolyzed Glucose Cycloacetoacetate on Coagulation Blood in normals and patients suffering from Metabolic Diseases.

M. C. NATH and INDU VAISHWANAR, Nagpur.

Glucose cycloacetoacetate (GCA) hydrolysate, methionine, choline, vitamin inositol and ascorbic acid when added separately to plasma and incubated w found to cause inhibition of stypven time. The inhibition of clot formation w more pronounced in case of hydrolyzed glucose cycloacetoacetate and choline a moderate with methionine and other substances. Such inhibitory action of gluc cycloacetoacetate hydrolysate and choline on clot formation was counteracted increased concentration of factor VII only. The effect observed was due to interference in the conversion of prothrombin to thrombin.

2. Fibrinolytic activity of the blood in experimental and clinical tuberculosis.

Mrs. V. V. CHIPLUNKAR and M. SIRSI, Bangalore.

Though the physiological role of the fibrinolytic system in the blood is f from clear, this lytic activity of the blood is considered to play a prominent ro in dissolution of the intravascular clot in wound repair and in haemorrhag diathesis. In acute experimental tuberculosis of guinea pigs a significant increa in the fibrinolytic activity is observed. This condition is associated with a increased fibrinogen level and thus differs from the enhanced lytic activity accom panied by afibrinogenaemia as seen in certain disorders of pregnancy.

No enhancement of the fibrinolytic activity was seen in the blood of chron tuberculous patients. Since they were on antituberculous drugs and vitamin therapy, the interfering influence of these compounds on the lytic actions of th disease as such, needs elucidation.

3. A New Method of Isolating Active Globulins from Native Antitoxic Plasma.

S. K. DUTTA, Calcutta.

During immunisation of horses with Welchii gasgangrene toxoid, the antitoxi property is well distributed over the γ- and β- globulins. In order to probe int the nature of these antibodies, primary problem is to get them in pure form, whic was still a problem. A simple and efficient method has been worked out. Nativ antitoxic plasma is precipitated with ammonium sulphate (at 15% conc.) to remov some non-specific bodies. The clear solution is subsequently treated with sodiur chloride (to 30% conc.) under which condition the antibodies are completely pre cipitated. The harvested precipitate is triturated in McILavain buffer (pH 3·2) t remove the residual unwanted proteins remaining undissolved. The clear buffe lution is finally retreated with ammonium sulphate (at 15% conc.) to precipitate wn the pure antibodies. The antitoxins thus obtained is free from salts by elec- odialysis using chromate-gelatin membrane. The antitoxin containing both γ- d β-globulin is then mixed with folic acid to precipitate down the strongly basic globulins, leaving the less positively charged β- globulin in solution. Each com- nent was freed from folic acid by equilibrium dialysis.

Studies on the Properties of Vinyl pyrrolidone polymer as a physiological transfusion material.

S. K. GANGULY, Calcutta.

Studies have been made on the effect of heat on the physiological solution of e polymer. The alteration of the polymer by way of change in pH by heat treat- ent has been observed which could be retarded by nitrogen and buffer solution. paper chromatographic study has been made and attempted to detect the altera- on of the polymer by using 95 per cent (v/v) alcohol as solvent and locating the ots of the iodine-complex by spraying with iodine solution.

The average molecular weight of the polymer was measured by intrinsic vis- sity as well as by osmometric method. While different batches of polymer of a rticular range of molecular weights have been used in the preparation of the lution for transfusion, the measurement of the average molecular weight of the dividual batch of the product is considered essential and at the same time, a rification of the uniformity of the composition of the polymer by observing the haviour of the solution of different batches in respect of viscosity, surface tension d specific gravity at different temperatures is suggested.

Various body fluid compartments in dogs.

M. L. GUPTA and V. B. MATHUR, Jaipur.

Various fluid compartments have been measured simultaneously in 21 dogs kept a standard diet.

The total body water varied from 5·73 to 9·781 (50 to 70% of body wt.), extra- llular fluid from 3·50 to 5·031 (26 to 51% of body wt.), intracellular fluid from 2 to 4·611 (20 to 32·92% of body wt.), blood volume from 77·7 to 92·5 ml/kg. dy wt., haematocrit from 47 to 60% and plasma volume from 34·9 to 48·1 ml/kg. dy wt. E.C.F. values bear an inverse relationship to body wt. but do not show y apparent sex variation.

Circulatory and respiratory responses to gastric distension.

M. L. GUPTA, Jaipur.

The effect of distension of various portions of stomach of healthy street dogs naesthetised with suitable fixed dose of Chloralose with various pressures on cir- ulatory and respiratory functions have been studied.

Distension of body of stomach causes fall of blood pressure with slowing of eart and increase in amplitude of cardiac action potentials. After injecting atro- ine (0·05 to 0·1 mg./kg. body wt.) gastric distension does not produce cardiac owing and the depressor response is less marked indicating that the depressor sponse is possibly due to diminished cardiac output and diminished peripheral sistance. Such distension also causes increase in respiration rate associated with minution in amplitude and tidal volume. The circulatory and respiratory effects distension persists without any decrement as long as the distension is maintained. he effects of distension of pyloric and cardiac end of stomach have been similar.

7. Behaviour of aortal elastic tissue of hypercholesterlaemic animals.

AJIT GOSWAMI and D. P. SADHU, Izatnagar.

The splitting and defraying of elastic tissue begin to occur much before th actual deposition of lipids in the aortic tissue of atherosclerotic animals. Th disruption of elastic tissue results in increased distensibility (both radial and long tudinal) of the arterial tissue. The lipid deposition in atherosclerosis occurs pr dominantly at branching points at particular sites with respect to flow-directio The deposition of lipids at these points can be explained in terms of decrease damping and by the phase-shift in wave reflection at the branching points of th distensible aorta.

8. Improved methods of Plethysmography.

B. S. KAHALI and M. L. GUPTA, Jaipur.

During the course of our study on the pressor mechanism of gastro-intestina stretch receptors the common intestinal oncometers were found unsatisfactory : glass intestinal plethysmograph was improvised from an isolated organ bath tub of wide bore fitted with a rubber collar (a thin rubber sheet with a central hole at the wide end through which a piece of the intestinal loop of suitable length wa introduced into the oncometer. The loop forms a closely tight fitting junction with the rubbed collar. The oncometer was filled with warm tyrode's solution. Th narrow stem of the bath was connected with the recording tambour.

The limb plethysmograph, as commonly used with a rubber collar attached t the broad end of the plethysmograph gave very indifferent recording of the pul satile blood flow into the limb. Instead, a sleeve of the skin obtained by a circula cut of the skin of the limb just proximal to the broad end of the plethysmograp and everted for half and inch all round, was tied over the end of the plethysmo graph. This modification of fixing the plethysmograph gave excellent results.

9. A modified technique of blood collection for exygen estimation.

B. S. KAHALI and M. L. GUPTA, Jaipur.

During the course of investigations a new technique has been devised for blood collection. A 10 c.c. luer lock syringe is moistened with a solution containing 60 mg. of sodium fluoride and 100 mg. of heparin in 15 c.c. of 0·85% sodium chlorid solution. The excess is expelled and 0·25 c.c. of mercury is drawn into the syringe. It is then connected to the proximal end A of a three way stop-cock. The dista end C is connected to the venous Catheter or the arterial puncture needle. The side end B is connected through a small bored transparent rubber tubing with another syringe. In the beginning A and B are connected and the excess of mercury is expelled from the first syringe through B filling the space from A to D (junction) with mercury. Now B and C are connected and about 2 ml. of blood is drawn into the second syringe, preferably heparinized to facilitate cleaning, attached to B of the three way stop cock. The blood that remains in the space between C and D is not exposed to air but is in contact with mercury filling the space from D to A and the first syringe. A and C are now connected and desired amount of blood is gradually drawn into the collecting first syringe. The stop-cock is then turned to close the syringe which is disconnected and slightly tilted so that the mercury trickles into the nozzle and forms a seal.

). Electrocardiographic Studies in Cow-Calves.

S. N. RAY and D. N. MULLICK, Izatnagar.

Seven cow calves were divided into two groups of four and three in each group. he animals in the first group were receiving only milk for the whole of this servation period. The second group of calves was reared first few weeks on milk d afterwards on calf ration. Electrocardiogram tracings were recorded in each imal at monthly intervals. Equipment and methods were the same as have been sed for human-beings.

The PR & QRS intervals showed some variation between control and experi- ental groups whereas very little differences were noted in the amplitudes of fferent waves. With the progress of observation (five months) the average values both the groups failed to show any appreciable variation. Some individual calves milk group demonstrated lower heart rate and smaller amplitude.

DIGESTION AND METABOLISM

1. The effects of gastric distension on gastrointestinal motility and secretion.

M. L. GUPTA, Jaipur.

The influence of gastric receptors on gastrointestinal motility and secretion has een studied on healthy street dogs anaesthetised with suitable fixed dose of chlo- alose or morphine urethane. Distension of body of stomach causes marked in- rease in tone and rhythmicity of descending colon and rectum while duodenum, junum and ileum show lesser effect. Such distension also causes increase in gas- ic and duodenal secretion while the rest of the gut is not affected.

The distension of pyloric portion gave similar results except that the biliary ecretion was very much increased. The distension of cardiac end also gave similar esults associated with diminution of tone and rhythmicity of stomach. The motor nd secretory responses are better marked under 20 and 40 than 10 mm. Hg. pres- ure. When the distension stimulus is discontinued, the motor effects disappear t the secretory effects continue suggesting that the motor effects are due entirely nervous mechanism while the secretory are due to humoral or dual mechanisms.

2. A study of jejunal and ileal stretch receptors.

B. S. KAHALI and M. L. GUPTA, Jaipur.

The effect of distension of jejunum and ileum of healthy street dogs anaes- etised with suitable fixed dose of chloralose with various pressures on circulatory, spiratory and alimentary functions have been studied.

The effects on the circulation and the respiration were similar to those caused y duodenal distension reported previously but of less intensity. The effects with junal distension were more marked than those of ileal distension suggesting a escending gradient of receptor activity. After injecting atropine (0·05 to 0·1 g./kg. body weight) distension of these regions produced no cardiac slowing indi- ating that it was entirely a reflex effect mediated via the vagus. However the ressor response was more marked as the rise of blood pressure due to vascular ffect was not counteracted by cardiac slowing.

The effects on gastrointestinal motility were similar to those of the duodenal istension that unlike duodenal distension jejunal and ileal distension caused in- reased motility of the stomach. The duodenum first showed diminution of tone nd rhythmicity but subsequently there was increase in tone and rhythmicity with jejunal distension. The other regions of the intestines (small and large) responde by increased activity. The jejunal distension showed increased gastric secreti while ileal distension showed slight increase in the beginning but later on no effec was seen. The rest of the gut did not show any secretory change.

13. Studies on Pulse Protein: Part V Enzymatic Liberation of Absorable N from Bengal gram Protein.

T. S. DE, Calcutta.

The primary factor which determines the utilization of a dietary protein is th timely availability of all the liberated N for body metabolism. The rate of releas of the total N including α —amino N from pulse protein has been studied by subjecting it to *in vitro* digestion by successive action of the proteolytic enzymes. The rate of liberation of total soluble and α —amino N at all stages of enzymati digestion seems to be slightly slower with pulse protein in comparison to that with casein protein.

14. Lipogenesis in Adipose Tissue of rats fed different diets.

J. M. KHANADE and M. C. NATH, Nagpur.

Lipogenesis and glucose uptake by epididymal fat pads of rats fed different diets have been investigated. Lipogenesis was found to be depressed in rats fed high-fat, high-protein, thyroid, thiouracil, and thiamine-deficient diets. The same dose of insulin causes varying degrees of lipogenesis in the tissues, depending on the type of diet fed previously. Lipogenesis is above normal in hydrolyzed glucose-cycloacetoacetate-fed rats but glucose uptake is not appreciably affected. The glucose uptake of adipose tissue is significantly depressed in rats fed high fat, high fat with high protein, and Vitamin B_1—deficient diets, and in hypothyroidism. Both hyperthyroidism and hydrolyzed glucose cycloacetoacetate feeding increase glucose uptake by the tissue. Alloxan diabetes reduces lipogenesis as well as glucose uptake.

15. Studies on the effect of feeding some common cooking oils on the lipid fractions of blood plasma of rhesus monkeys.

SACHCHIDANANDA BANERJEE, PULAK KUMAR GHOSH and
ASOK BANDYOPADHYAY, Bikaner.

Rhesus monkeys were fed a basal diet containing 2% fat and 15 mg. cholesterol per 100 gm. of the diet and the plasma contents of total cholesterol, ester cholesterol, phospholipid, lipoproteins and nonesterified fatty acids were estimated. Some of the animals were fed 3 gm. cholesterol mixed with the diet with or without the different oils such as mustard oil, coconut oil and sesame oil. Blood constituents of the above mentioned components were estimated at intervals after the different diets were administered. Fecal excretion of sterols were also estimated.

The feeding of cholesterol for a period of 4½ months did not affect the plasma and ester cholesterol. A slight elevation was observed after 6½ months of feeding cholesterol. Plasma cholesterol level rose when the cholesterol fed monkeys were supplemented with mustard oil, coconut oil and sesame oil but the rise was maximum in the animals fed sesame oil. Up to the third month of the experiment the fecal excretion of the sterols did not change in the animals fed cholesterol with or without mustard oil or coconut oil. The excretion diminished from the third onth in animals fed sesame oil and the diminution was maximum in the sixth onth. The excretion diminished from the fourth month in the group receiving conut oil and from the sixth month in the group receiving mustard oil. There is no change in the lipoprotein fractions. The plasma nonesterified fatty acids creased after cholesterol fteding and when cholesterol was fed along with sesame l the rise was maximum.

The results indicated that saturation or unsaturation of the oil probably are not ncerned with the absorption and consequent elevation of plasma cholesterol. me constituents of the oil other than its saturation or unsaturation are possibly sponsible for the absorption of cholesterol. A considerable rise in the nonesterified tty acids of plasma along with a rise in the cholesterol level suggests a direct lationship of both these constituents of plasma.

6. Effect of Tetracyclines on Carbohydrate and Lipid Metabolism.

SACHCHIDANANDA BANERJEE, K. G. PRASANNAN and
PULAK KUMAR GHOSH, Bikaner.

Glucose tolerance was lowered in rabbits and rats after the animals were fed rramycin, 5·7 mg./100 gm. body weight/day, for 6 days. Liver glycogen also iminished in rats under terramycin treatment. No such effects were observed in ats similarly treated with achromycin.

There was increased cholesterol content of the whole body of rats treated with rramycin or achromycin indicating increased biogenesis of cholesterol after the dministration of the antibiotics. Phospholipid contents of various tissues increased fter treatment of the rats with terramycin or achromycin although the phospholipid urn over in the whole body did not change.

7. Tissue respiration in cystine-fed rats.

IVA CHATTERJEE, B. B. GHOSH and D. P. SADHU, Calcutta.

Cystine fed to rats produces fatty liver, especially with a low protein diet. stine increases growth rate of tissues, thus increasing the requirement of labile ethyl groups and thus resulting an induced choline deficiency and fatty liver. issue respiration of liver and kidney slices has been studied in control rats fed n synthetic complete diet and the experimental rats fed on additional dose of stine in their diet daily. Histochemical observations have demonstrated fatty ver in cystine-fed rats. The liver QO_2 to succinate substrate was increased in stine fed rats, but QO_2 of liver and kidney to pyruvate or succinate substrate owed a decrease in experimental animals. A possible mechanism of decrease of ssue respiration is discussed.

8. Effect of Vitamin B_{12}, unsaturated fat and Hydrolyzed Glucose Cycloacetoacetate on bile acids excretion in experimental Hyperlipemia.

M. C. NATH and D. M. BRAHMANKAR, Nagpur.

The effect of vitamin B_{12}, unsaturated fat and hydrolyzed glucose cycloacetoacetate (GCA) on the total plasma cholesterol levels and on the excretion of fecal ile acids has been studied in rats in which hyperlipemia was induced by feeding aturated fat. These substances have been found to increase the output of fecal ile acids with a concomitant fall in total plasma cholesterol levels, thus indicating heir important role in increasing the metabolism of cholesterol in the living system hrough its conversion to bile acids. Hydrolyzed GCA was found to be most effecive in this process.

19. Studies on Pulse Protein: Part VI Tissue Nitrogen on Pulse Diet.

T. S. DE and G. C. ESH, Calcutta.

Tissue growth and maintenance of its nitrogenous integrity are important functions of dietary nitrogen. This paper reports the nitrogen content of various body organs of rats fed and maintained on pulse and casein protein diets. The extent and rate of regeneration of tissue nitrogen was followed in protein-depleted adult rats during repletion on these protein diets. During growth the distribution of nitrogen was found to be greater in almost all the organs with casein protein diet. Each organ seemed to have its own individual tempo with respect to the quality of dietary N in the process of disintegration and regeneration. On repletion all the depleted organs, however, seemed to regenerate at a little slower rate on pulse protein diet than on casein protein diet.

20. Effect of Pulse Protein diets on the Transaminasing Activity of plasma and other tissues in rats.

J. M. SOM and G. C. ESH, Calcutta.

The levels of aspartic-glutamic and alanine-glutamic transaminase activities of plasma, liver, heart and kidney have been studied in growing rats maintained on pulse protein and casein diets at different levels of protein intake. Similar enzyme activities were followed in adult rats after protein depletion and repletion on these two test protein diets. The enzyme activities are depressed at the lowest level (6%) of protein intake and such depression is more prominent in case of pulse protein diet and in alanine-glutamic transaminase activity particularly in the liver and heart. Partial protein depletion results in the significant lowering of enzyme activities in the liver, more so in alanine-glutamic transaminase activity which can be effectively restored by feeding 18% casein protein diet for 4 weeks but less effectively by pulse protein diet. The significance of the changing transaminase activities under different protein feeding conditions has been discussed in relation to the utilization of dietary proteins.

21. On the study of the changes in the chemical composition of blood and liver tissue in partially hepatectomized animals.

M. L. PAI, Baroda.

Some of the changes in the chemical composition of the liver during regeneration in laboratory rats after partial hepatectomy have been studied in an attempt to find a correlated chemical description of regenerative growth of the liver tissue in these animals. The changes in the chemical composition of the blood of these animals were also observed and compared with the changes in the chemical composition of the liver tissue during regeneration. It was observed on comparing the composition of the regenerated tissue with that of the corresponding normal liver tissue on dry weight basis, that the chemical constituents, e.g. total proteins, albumin, globulin, and total lipids were restored to normal or nearly normal during the period of 8 days after the operation for partial hepatectomy. On comparing the composition of blood of normal and hepatectomized animals, with the composition of liver tissue, both normal and regenerated, it was found that the blood constituents studied were coming to normal, as was seen in case of the chemical constituents of the regenerating liver tissue, which were like-wise observed to be coming to almost the normal level during the period of eight days after the operation for partial hepatectomy. The significance of the above findings has been discussed in the paper.

22. Determination of body surface area in Indian Hindu Children.

SACHCHIDANANDA BANERJEE and ASHIM KUMAR BHATTACHARYYA,
Bikaner.

Body surface area (BSA) was measured in thirteen Indian Hindu Children, of ages varying between 3 and 12 years, with tape and surface integrator. In 9 out of 13 children the results obtained were lower than the body surface area (BSA) calculated with the weight-height formula of Du Bois and Du Bois. Based on the actual measurements a new constant for the weight-height formula was obtained and a new equation, Surface Area $(\text{cm}^2) - \text{Weight}^{0{\cdot}425}_{(\text{kg.})} \times \text{Height}^{0{\cdot}725}_{(\text{cm.})} \times 70$, has been suggested for the BSA of Indian children. A nomogram for reading off surface area in metric units based on the above formula was prepared. A significant difference existed between the BSA calculated with new formula and that of Du Bois and Du Bois.

23. Studies on the Efficiency of the Athlets in Sports.

SUSHILRANJAN MAITRA, SANKAR NATH KOYAL and SHAKUNTALA
GUPTA, Calcutta.

In sports the persons are grouped according to the age or height and the efficiency is recorded according to the position the subject occupies. But what is the work load on the man is not taken into consideration normally as with the higher work load a person is put to a premium with the person who is working with a lower work load for the same event of the sports. We undertook the study to find out the relation of work load and the efficiency of a person in any event.

The subjects were selected from the Calcutta University sports, who are supposed to be the trained athletes and also from the students of University College of Science and Technology, taken at random. 15 male and 5 female subjects were taken and following records were noted in 100 and 50 metres run respectively. The ages were usually between 20—25 years, height between 150—175 cm. weight 39—57 kg., initial pulse rate 68—100 per minute, final pulse rate 147—180 per minute, initial ventilation rate 8·5 litres to 35 litres per minute immediately after the run. The time taken for the heart rate to come to normal is between 10—20 minutes in sitting relaxed condition, after the events.

The actual work performed per unit second of time in kg. per second plotted in the graph which is obtained by body weight × distance travelled. It is very interesting to note that the candidate who stood first has done the minimum work in kg. per second in comparison with the candidate who stood last and has done maximum work.

It would have been more logical if all the persons were put to same load of work. According to the study it will be better perhaps if the efficiency is to be judged clearly and scientifically by putting the same work load to a particular height groups or age groups.

24. Maximal Working Capacity of Persons Between 20-25 Years And Its Relation to Blood Lactate Concentrations.

SUSHILRANJAN MAITRA and SANKAR NATH KOYAL, Calcutta.

Fatigue is produced when a person is put to his maximum working capacity and this phenomenon produces changes in blood constituents and of these lactate may vary from person to person with respect to his working condition. How far the fatigue as noted by external symptoms as also the heart rate and respiratory rate has a particular relation with blood lactate concentration with average young man of our country will be an interesting point of study. Various data are available from foreign countries. In these experiments we have selected 20 Postgraduate students. The subjects were put on the bed at a room temperature of 28°C in a completely relaxed condition both in physical and mental rest. 5 c.c. of blood was collected from each subject, out of which 3 c.c. was separated for determination of lactic acid and 2 c.c. for other estimations. The lactic acid concentration of the resting blood was found to be 18 to 22·5 mg.% with an average value of 20·0 mg.%. The standard deviation and standard error of mean appear to be ±2·94 and 0·73. The lactic acid concentration of the blood immediately after the work was 54 to 101·1 mg.% with an average value of 78·11 mg.%. The standard deviation and the standard error of mean of this analysis were found to be ±12·1 and 3·02 respectively. The values of lactic acid after the work are generally low and it is difficult to say whether the subjects have strained themselves to the real fatigue point. The difference in alkali reserve does not seem to be essentially important for reaching high lactate concentration. The lowering of buffering action by injection of ammonium chloride has got no relationship with work or blood lactate concentration. The rise of lactic acid concentration depends on the amount of work done anaerobically and consequently it depends on the adaptation of the respiration to carry the necessary oxygen to the working muscle. With the subjects the work load was 900 kg. per minute and the steady state was reached for a very short period of time. This shows the respiratory and circulatory adjustment is geared to a lower grades of work and consequently this 900 kg. metres work is proving to be a high grade of work to these subjects.

25. Analysis of Physical Performance and Growth Characteristics of Bengali School Going Boys.

SUSHILRANJAN MAITRA and SANKARNATH KOYAL, Calcutta.

Random subjects of 100 school-going boys from a residential school in south Calcutta, ages between 7-17 years, were taken and their age in years, body weight in kg. height in cm. chest diameter in inches etc. were recorded. The results of this study are plotted on an arithmetic graph paper taking age groups, as the abscissa and height as ordinate. Similarly, other findings of weight, pulse rate, respiratory rate, vital capacity, sitting height, chest girth, jumping height etc. are plotted against the age groups as abscissa. A parabolic type of curves was found. It is very interesting to note that the increase in vital capacity is not always proportional to chest girth. It has been found that the jumping height does not increase with age, but there is a relationship between jumping height and height. From the literature of the foreign countries it seems that there is a better relationship if the trunk length is taken as abscissa instead of total height.

26. Physical Development of Bengali School Children.

P. N. SENGUPTA, Calcutta.

In an investigation under the auspices of UNESCO, 1092 boys and 210 girls of 5 to 15 years age groups, reading in schools and living in rural and industrial areas of West Bengal, were measured for stature and weight for determining their nutritritional status and physical development. The measurements were classified according to three groups of subjects: Groups I & II—Hindus and Group III—Muslims. The average measurements corresponding to each age group of these boys and girls were calculated along with standard deviations.

The group I boys were taller at each age but the group II boys were heavier up to 10 years age and thereafter their development had downward trend. The overall growths of group I boys in stature and weight were highest as compared with those of the boys of other groups. The overall growths of all the boys and girls from 5 to 15 years age in stature and weight were respectively 54·7 cm. and 47·5 cm. and 26·1 Kg. and 25·8 Kg. The indices of nutrition and body build reveal satisfactory developments in groups I and II. The developments of Bengali boys have been compared with those of the boys of other countries.

VITAMINS AND HORMONES

27. Studies on the Ascorbic Acid status in Hypervitaminotic A Rats.

SUDHINDRA CHANDRA RAY and D. P. SADHU, Izatnagar.

Fiftyfour male albino rats weighing about 60 g. were divided into three series. In series I, 18 rats were divided into three groups of (1) control rats fed stock diet ad lib, of (2) hypervitaminotic A rats fed 30,000 I.U. vitamin A per day and of (3) pairfed rats fed the same amount eaten by the hypervitaminotic A rats. Ascorbic acid content of 24 hours urine was estimated and the excretion initially was found to be increased followed by a decrease, while in the tissue such as liver, kidney, brain and suprarenal there is a decrease. In series II ascorbic acid saturation test was made by feeding one mg. ascorbic acid per 100 g. body weight and the hypervitaminotic A group showed reduced excretion in urine. In series III the rats were fed 1 mg. ascorbic acid per 100 g. body weight for 6 days and the hypervitaminotic A rats excreted larger amount of ascorbic acid in urine and showed a smaller content in the tissue. It is concluded that hypervitaminotic A reduces the power of utilization of ascorbic acid in the tissue.

28. Interrelationship of Dietary Protein and Vitamin A in Metabolism: Part IV. Effect of low and high intake of Vitamin A on the maintenance requirement of Dietary Nitrogen in Rats.

R. K. BHATTACHARYA and G. C. ESH, Calcutta.

Young adult male rats after being made vitamin A deficient were fed two dietary levels each of casein and Bengal gram proteins. Both the levels were associated with negative nitrogen balances. The linear relationship between truly absorbed nitrogen and nitrogen balance was described by regression equations fitted to the data by the method of least squares.

Effect of low and high intake of vitamin A on the amount of truly absorbed nitrogen (corrected for the metabolic nitrogen in feces) required for nitrogen equilibrium was computed from these regression equations to be 4·20 and 3·47 mg. of casein nitrogen and 5·07 and 4·11 mg. of Bengal gram nitrogen per day per basal calorie, respectively. The amount of truly absorbed nitrogen required for the maintenance of constant body weight on feeding low vitamin A was found to be 6·92 mg. of casein nitrogen and 7·83 mg. of Bengal gram nitrogen; while, when fed high vitamin A, the amount required were 5·23 mg. of casein nitrogen and 5·88 mg. of Bengal gram nitrogen, the values being expressed per day per calorie of basal heat.

True digestibilities of both the proteins tested in low and high vitamin A fed rats were not different, whereas biological value and net protein utilization of both the proteins are lowered in rats fed low vitamin A when compared to the values obtained from rats fed high vitamin A.

The results thus indicate the extent of vitamin A intake significantly affects the metabolism of dietary proteins for their effective utilization.

29. Vitamin A Metabolism in Normal Subjects.

M. L. GUPTA and R. L. AJMERA, Jaipur.

Metabolism of vitamin A in 10 normal Indian subjects of low income group was studied. The resting plasma levels of vitamin A and carotenoids were 48·7±4·8(29·4—84·8) and 69·5±7·5(41·2—112·5) μg % respectively. The concentration of vitamin A is more or less similar to the observations of foreign workers, while carotenoid concentration is appreciably lower than in the foreign subjects (average 137 μg %), possibly due to low dietary intake of provitamins by Indians. None of the subjects excreted vitamin A or carotenoids in urine.

Vitamin A tolerance was studied by giving orally a massive dose of 3 lac I.U. vitamin A (Glaxo). 5 hours after the test dose the plasma level of vitamin A rose to 152·5±6·3 μg % and came down to 56·1±6·1 μg % in 24 hours. The plasma carotenoid level after 5(70·5±7·3 μg) and 24 hours (66·6±6·1 μg) did not show any significant change. No vitamin A or carotenoids were excreted in urine after the test dose except in one case who excreted 16·1 μg. of vitamin A in 24 hours which may possibly be due to some sub-clinical renal damage.

30. Effect of different spices on Thiamine Synthesis in Rats.

M. C. NATH and S. K. MEGHAL, Nagpur.

Mustard when given at the level of 2% in the diet replacing the same amount of sucrose in thiamine inadequate diet, could increase the urinary and faecal excretion of thiamine in rats with greater storage of thiamine in tissues. It also increased the cecal coliform count thereby indicating that mustard helps in the intestinal synthesis of thiamine. Dry ginger also increased the urinary and fecal excretion of thiamine up to 4th week after which it was reduced. The turmeric had no enhancing effect on the biosynthesis of thiamine while the black pepper fed animals could not survive during the experiment on such a high level (2% of the diet).

31. Liver Transaminase Activity in Riboflavin Deficiency.

S. C. JAMDAR and SAILEN MOOKERJEA, Calcutta.

Liver homogenates of the rats on a riboflavin deficient regimen show increased alanine-glutamic and aspartic-glutamic transaminase activity, the rise being more pronounced in the former. When the dietary protein level is increased to 40%, the changes of transaminase activity seem to fall off.

During a stage of dietary protein depletion the liver transaminase activities decrease both in control and riboflavin deficient animals, but on a subsequent stage of protein repletion the ratio of liver weight and its nitrogen content to body weight, liver transaminases and catalase activity seem to increase significantly in riboflavin deprived animals compared to their controls.

2. The Conversion of C^{14} Labeled Glucose Cycloacetoacetate to l-Ascorbic Acid in Germinating *Phaseolus Radiatus.*

M. L. BELKHODE and M. C. NATH, Nagpur.

A comparative study was made by imbibing uniformly labeled glucose and beled glucose cycloacetoacetate (with glucose moiety uniformly labeled) to *phaseo- us radiatus*. The yields of ascorbic acid in terms of C^{14} from glucose cycloaceto- cetate was four times greater than obtained with glucose.

The experiments conducted with Glucose-1-C^{14} Cycloacetoacetate resulted in scorbic acid formation with 68-73 per cent of activity occurring in C-1 and 14-18 er cent in C-6.

Ascorbic acid from Glucose-6 C^{14} Cycloacetoacetate labeled seeds contained 3-18 per cent activity in C-1 and 64-69 per cent in C-6. The experiments suggest hat in *Phaseolus radiatus* asymmetrically labeled glucose moiety of glucose cyclo- cetoacetate is converted to ascorbic acid with intact carbon chain and without ts inversion.

33. Studies on Pulse Protein: Part VII Influence of some Anabolic Steroid Hormones on the Utilization of Bengal gram Protein in Rats.

T. S. DE and G. C. ESH, Calcutta.

Hormones are known to play a great role in the metabolism of dietary proteins. lthough their effects are not identical it is likely that the nature of proteins significantly influences their formation and function. The part played by the well-known anabolic hormone, testosterone has been followed in rats maintained on pulse protein diet in relation to their growth, protein efficiency ratio and N retention. Similar studies have also been made with synthetic steroid hormones with a view to finding out their possible importance under conditions of feeding restricted protein diets. The results tend to indicate that both the natural and synthetic hormones significantly effect the metabolism of pulse protein to the best dvantage of the subjects.

34. The role of Adrenal Cortical Hormones in Allergy : Part IV—*In Vitro* Release of Histamine from Rat skin after Dextran.

B. N. CHOWDHURI, Calcutta.

Rat skin suspended in oxygenated tyrode solution at 37°C was found to release some histamine in solution. When dextran solution was added to the above solu- ion there was further release of histamine from the rat skin. The histamine was determined biologically on cat blood pressure (carotid) and atropinised guineapig ileum. The release from skin of normal rats was found to be 9·3 μg (average) histamine base per gram of skin; when dextran solution was added, there was further release of histamine to the extent of 8·8 μg (average) histamine base per gram over initial i.e. a total of 18·1 μg (average) per gram. After injection of corti- sone acetate 7 mg/100 g. daily for 7 days, the release of histamine was 7·4 μg and 0·92 μg histamine base per gram, before and after addition of dextran i.e. a total 8·32 μg per gram.

In adrenalectomised animals these figures were 9·0 μg and 27·16 μg before and after addition of dextran in non-injected animals i.e. a total of 36·16 μg per gram; in animals injected with cortisone these figures were 6·5 μg, 9·24 μg and 15·74 μg (total) histamine base per gram.

The above observations indicate that amount of releasable histamine in ra skin is reduced after injection of cortisone acetate in both normal and adrenalectomised rats. Addition of dextran has practically no effect on further release o histamine and the animals appear to have been protected from the action o dextran in respect of histamine release.

35. The role of Adrenal Cortical Hormones in Allergy: Part III--Skin Histamine Content of Rat.

B. N. CHOWDHURI, Calcutta.

Skin histamine content of rats was determined before and after adrenalectomy. The effect of injections of glucocorticoids for a few days on skin histamine content was also studied. Histamine after extraction was determined by the biological methods on cat blood pressure (carotid) and on atropinised guineapig ileum. The skin (abdominal) histamine content of rats was found to be 27·3 μg (average) histamine base per gram of skin. When the animals were injected with cortisone 7 mg/100 g. daily for 7 days, the histamine content was found to be reduced to 9·07 μg (average) histamine base per gram. In case of adrenalectomised animals these figures were 72·7 μg and 39·4 μg histamine base per gram of skin for non-injected and injected (cortisone acetate for 7 days) animals respectively.

From the above observations, it is evident that after adrenalectomy, there is increase in histamine content of skin of rats and that both in normal and adrenalectomised rats injection of cortisone acetate for a few days produced reduction of skin histamine content in each case.

36. The Metabolic effect of sex Hormones in Dogs.

M. L. GUPTA and V. B. MATHUR, Jaipur.

The effect of administering 3 sex hormones viz., testosterone, oestrogen and progesterone on body weight and total body water content was studied in adult dogs of both sexes. Observations were made with 2 different levels of the hormones. Increase in body weight along with increase in body water content was observed in all the experimental groups. With testosterone the increases were found to be more with higher doses of the hormone. The body weight increase was however found to be less than the total body water rise indicating thereby a possible reduction in solid mass. With oestrogen, the increases were more marked in females where increase in body weight was greater than increase of body water content. But in males the effect was however like that of testosterone. With progesterone the increases were, on the other hand, slightly more in males—where higher doses also imparted more increases. Increase in body weight was observed to be more than the increase in body water content in males but with females the case was reverse. The observations thus tend to indicate the possible catabolic effect of testosterone in both sexes; of oestrogen in males and of progesterone in females; and the anabolic effect of oestrogen in females and progesterone in male dogs.

37. The effects of sex Hormones on body fluid Compartments.

M. L. GUPTA and V. B. MATHUR, Jaipur.

The effects of 3 sex hormones, viz., testostersne, estrogen and progesterone on various fluid compartments were studied in adult dogs maintained on standard diet. All these hormones were tried at two dicerent levels. The total body water content as well as the extra and intracellular fluid showed rise in the testosterone and estrogen administered animals. With both these hormones again the rise was observed to be more with but not proportionate to dosage increment. With testosterone the increases seemed to be mainly due to rise in extracellular fluid and R.B.C. volume and the effect was better observed in males. With estrogen diminition in haematocrit values was noticed and all its effects seemed to be independent of sex differences. With progesterone the effects were less marked and less constant.

ANIMAL NUTRITION

38. Oxygen Consumption in Buffalo Calves.

M. V. N. RAO and D. N. MULLICK, Izatnagar.

12 Murrah buffalo calves of one to six months old were used for recording the oxygen consumption rate with the help of a Benedict Roth metabolism apparatus. A suitable face mask was used.

The oxygen consumption rate per minute increased with increase in body weight. Per unit body weight, the calculated consumption rate decreased with the increase in weight. The correlation coefficient between body weight and oxygen consumption rate per minute was found to be prositive and highly significant.

A regression equation was calculated between the body weight in kilogramms and oxygen consumption rate in calories per minute and a stright-line relation was existed. Under field conditions, this method can be used to measure the cloric requirement from the known body weight.

39. Oxygen Consumption in Hariana Calves.

M. V. N. RAO and D. N. MULLICK, Izatnagar.

Oxygen consumption was estimated in young calves with the relp of Benedict Roth metabolism apparatus.

The consumption maintained a significant positive correlation with the increase in the body weight but when calculated per unit body weight, an inverse order was followed.

A straight line relationship was found according to regression equation between the oxygen consumption and the body weight. The differences between the calculated and the observed values were insignificant.

Under field condition, the oxygen consumption or caloric requirement of calves can be estimated from the known body weight with the help of this equation.

40. Studies on the Feeding of *Lantala* Silage.

O. N. AGARWALA, S. S. NEGI and V. MAHADEVAN, Izatnagar.

Cases of livestock poisoning on *lantana camara* are well known. Due to its abundant availability in many areas particularly during scarcity periods, it was suggested if the plant could be utilised as a normal feed after processing, *viz.*, ensilage.

Two adult Kumauni bullocks fed on *lantana* silage showed clinical symptoms of *lantana* poisoning and the post-feeding blood picture of the animals for haematological and biochemical constituents was comparable to that of photosensitised animals.

41. Effects of Supplementing Milk Diet with Magnesium on the growth, Blood Composition and Endocrine Weights in Rats.

RENUKA MISRA, BIMLA KAKKER and D. N. MULLICK, Izatnagar.

Two groups of 12 young rats were fed only cow and buffalo milk. 3, 6 and 9 mg. of magnesium in solution were fed daily. Weekly body weights were recorded for 11 weeks, after which the animals were sacrificed. The blood and serum of individual animal were analysed for haemoglobin, calcium, magnesium and cholesterol and thyroid and adrenals were weighed. Results indicated that the supplemented groups on cow milk diet showed improvement in the growth rate but lowering in the serum calcium and cholesterol. The weight of the endocrines registered a negative relation with the increase in the dose of supplementation.

The buffalo milk contains higher amounts of some nutrients which cause the significant increase in the growth rate in comparison to the groups on cow milk. The addition of magnesium failed to show much difference from the control in all the constituents analysed. It may be presumed that the supplemented level of magnesium is not sufficient to show any effect in presence of higher level of fat.

42. Effect of Copper and Cobalt Supplementation on the Blood Constituents in Young Growing Hariana Calves.

P. K. DWARK NATH, V. S. BISARIA and V. MAHADEVAN, Izatnagar.

In an endeavour to assess the effect of copper and copper with coblat supplementation on the health of the young ruminants an experiment was designed with 10 Hariana calves over a period of one year. The calves were given basal ration supplemented with copper and cobalt in varying levels.

Periodical bleeding once in a month was carried out and the blood constituents were estimated. The copper content in the whole blood of the groups fed copper and copper supplemented with cobalt remained higher; the Cu with cobalt supplementation, however, helped to maintain the blood copper level to the maximum.

The haemoglobin levels as well as the erythrocytic counts of copper with cobalt group were also found highest.

The leucocytic counts were, however lower, in the copper with cobalt fed group.

Serum calcium and inorganic phosphorus in blood did not reveal any significant alteration in experimental groups.

The cobalt and copper supplementation thus seem to be helpful in calf feeding even if rations are not deficient in copper or cobalt.

43. Studies on the Metabolizable and Productive Energy of Poultry Rations.

H. R. SHARMA, P. V. RAO, R. MUKHERJEE and S. BOSE, Izatnagar.

The present investigation was carried out with a view to compare the reproducibility of the Metabolizable energy (M.E.) and Production energy (P.E.) values of poultry feeds. For this purpose, two experiments were conducted on growing R.I.R. chicks using two rations of which only one contained animal protein. The M.E. and P.E. values were determined on chicks at 0-8 weeks of age. In each experiment, the birds were randomly grouped into two batches and the chosen ration was fed *ad lib.*

The M.E. values at two-weekly intervals in the two experiments ranged from 2·17 to 2·42 K. cals/g. of diet on dry matter basis and indicated a constancy at various stages of growth and reproducibility in duplicate experiments. On the other hand, the P.E. values of the rations at different stages of growth ranged from 0·84—1·17 K. cals/g. of dietary dry matter. For the same ration there was a wide variation in the P.E. values at the different stages of growth and the reproducibility of the values in duplicate experiments was poor. It is concluded that in comparison with P.E., the M.E. is a better measure of the energy value, by dint of easier estimation and better reproducibility.

44. Studies on the Toxicity and Nutritive Value of Fungus-Free *Paspalum Scrobiculatum* grains.

O. N. AGARWALA, S. S. NEGI and V. MAHADEVAN, Izatnagar.

Paspalum scrobiculatum (*kodo*) grains were raised from a toxic variety of seeds. The grains produced were found to be free from fungus and when fed to albino rats over a prolonged period did not produce any symptoms of poisoning.

The nutritive value of fungus free grains of *Paspalum scrobiculatum* has been evaluated by replacement by *kodo* seeds of 0,25,50 and 75 per cent of the combined basal moiety consisting of 70 parts maize flour, 25 parts gram flour and 3 parts wheat bran in the adequately supplemented stock diet of rats. The growing albino rats when placed on the different diets for a period of ten weeks were found to fair equally well. The average digestibility of crude protein and the average nitrogen, calcium and phosphorus balances of rats on the experimental diets were quite satisfactory.

It appeared that P. *scrobiculatum* grains produced under normal conditions may be profitably utilized as a normal ingredient of the diet of laboratory rats or other animals in place of cereal or millet grains.

45. Effect of Supplementation of Poultry Ration with "Brewer's Dried Yeast."

H. P. TANDON, G. V. RAO and S. BOSE, Izatnagar.

Studies have been made to find out the effect of supplementing the poultry ration, consisting of yellow maize, barley, wheat bran, groundnut cake, fish meal, calcium grit, bone meal and shark liver oil with dried Brewer's yeast at 2% level. The feeding trial was carried out on 70 chickens of R.I.R. breed from 8 weeks to 9 months of age.

The supplementation of the ration with yeast enhanced growth by 29·9% up-to 12 weeks of age indicating that it is very beneficial for broiler production. After the 12th week the increase in growth declined to 10·7%, 5·5% and 3·1% at 16, 20, and 24 weeks of age respectively.

Addition of yeast to the ration hastened sexual maturity by about 38 days in the pullets and increased average egg production up to 9 months by 15%. Average egg weight was however less by 2·17 drachms.

46. Provision of Artificial Light to Grown up Immature Pullets.

H. P. TANDON, G. V. RAO and S. BOSE, Izatnagar.

Studies have been undertaken to find out the effects of provision of artificial light to grown up Rhode Island Red pullets that did not commence laying till the end of October. The durations of exposure to artificial light were whole night and 2 and 3 hours in the morning and 2 and 3 hours in the evening both in continuation of day light. The experiment was commenced on 1st November and continued till the end of February.

The results of this experiment revealed that provision of artificial light grown up pullets of R.I.R. breed during winter months brought about the foll ing effects:

1. It hastened maturity by 9 to 17 days and that the stimulation in this resp was proportional to the extent of exposure up to 3 hours duraion. The whole nig exposure brought about practically the same results as the 3 hours exposure.
2. It increased egg production during the exposure period by 5 to 8 per cent
3. The morning and evening lights increased production during the 1st mon of the commencement of the exposure followed by a little decline during the ne 2 months and then again an increase in the 4th month of treatment.
4. The stimulation in respect of egg production brought about by whole nig light exposure decreased as the period of exposure advanced.
5. There was excessive mortality in the whole night exposure group.
6. The exposure to artificial light, its time and duration did not material affect the fertility and hatchability of the eggs laid by the exposed pullets.
7. Provision of light increased food consumption by about 5 to 9 grams p bird per day.

47. Studies on Blood of Growing Calves on Different Levels of urea Ingestion.

P. C. SAWHNEY, S. C. BISARYA and S. C. GUPTA, Izatnagar.

In order to study the influence of feeding urea on the blood composition c *Hariana* male calves, studies were conducted with 40 and 50% of digestable dietar protein replaced by urea. The feeding period was for 52 days. During mid-experi mental period no appreciable change was noticed in normal blood constituents whereas in post-experimental period analysis revealed slight increase in inorgani phosphorous, and appreciable increase in urea, urea N and N.P.N. contents of th blood on both the levels of urea supplementations. Increase of urea supplemen tation from 40 to 50% however, revealed no alteration in the blood constituents.

48. Preliminary Studies on the Effect of Aurofac Feed Supplement on chick fed a Typical Indian Village Ration, with Special Reference to Vitamin A Storage in the Liver.

P. G. PANDE, K. K. PAL, R. MUKHERJEE, P. V. RAO and S. BOSE, Izatnagar.

Antibiotic feed supplements are extensively used in the rations of chicks a growth stimulants. In order to determine the effect of Aurofac (a by product i Aureomycin manufacture) feed supplement on chicks fed typical Indian villag ration with special reference to vitamin A storage in livers, day-old chicks wer reared on typical village rations supplemented with Aurofac and vitamin A with without Lucerne meal. The average weekly food consumption was much lowe when the feed was not supplemented with Aurofac and Lucerne. The averag growth rate increased with supplementation. Lucerne supplementation favoure higher rate than Aurofac supplementation. Aurofac with Lucerne, however, im parted maximum growth rate. Mortality study revealed decrease in mortalit with Lucerne and Lucerne with Aurofac supplemented diets. Least mortalit was observed with Lucerne supplementation only. Carotene content in the live and blood in all groups of birds was inappreciable and liver storage of vitami A was very low in all the experimental groups.

Quantitative Feeding of Philosamia Ricini Hutt Larvae.

R. P. KAPIL, Ranchi.

The feeding experiments on the larvae of *P. ricini* were based upon the prinle of continuous and discontinuous feeeding. The larvae were fed at varying ervals of 4-hr., 6-hr., 8-hr. and continuously. In the main the idea was t ect suitable feeding schedule, based upon time interval and quantity of the tor leaves to be served at a time, to see the possibility of its economic feeding Eri-silkworms.

The experiments were conducted during February March when the average om temperature and humidity were 20·8 C and 45·22% (R.H.) respectively. The vae having yellow colour were drawn from experiments on segregation and perimental hybridation. The stock had shown 64% purity in the previous geneion and absolute in the current.

It was observed that in the 1st. intermoult 3 feeds and in the 2nd. to 4th. ermoults feeding at 4-hr. interval are sufficient. In the 5th. intermoult, it y be increased gradually by 2 or 3 feeds per day at the most, particularly om 3rd. to the 8th. day. Periodic starvation of the Eri-silkworm larvae lengthens e 5th. intermoult. Mortality is directly proportional to the feeding periods. It most in the 5th. intermoult. The mortality of the larvae for mounting is stponed by 2-days if each feed is delayed by 2-hr. Further delay of 2-hr. of feeding riod has a cumulative increase in maturity period of 3-days. Actual process of coon formation is not apparently effected except some adverse tendency in hr. lot.

HISTOLOGY AND HISTOCHEMISTRY

). Histological Changes in the Nerve Cells of Rats after Picrotoxin Administration.

(MISS) KRISHNA SIKDAR and J. J. GHOSH, Calcutta.

Attempts have been made to correlate the histological and histochemical anges in nerve cells of rats after picrotoxin administration, with other bioemical changes that are being started in this connection. Different regions of ain tissues were sectioned and stained with methylene blue, thionin and galloanin stains. Areas of nucleus and nucleolar portions of individual neurone cells re traced out by camera lucida and measured by planimetry. Measurements re mostly taken of neurone cells of normal and pictrotoxin-treated animals in e pons and medullary regions.

Preliminary determinations of nucleus and nucleolar areas reveal that both in e pons and in medulla, the nucleolar areas are significantly increased after picroxin administration, the areas of the nuclei are also increased but the increases are t so well-marked as in the cases of nucleoli. The nature of staining of Nissl ubstances, under identical conditions studied, reveals that the Nissl bodies undero partial chromatolysis because of their faint staining and granular in appearances.

1. Aortic Changes in Cholesterol-fed Chicks and Pyridoxine-Deficient Rats.

MADHUSADAN GHOSAL and D. P. SADHU, Calcutta.

A study on the changes in the elastic components of the aorta with a view to ie determination of its possible role in atherogenesis in hypercholesterolaemic onditions have been made. It has been observed that in pyridoxine-deficient rats and cholesterol-fed chicks splitting up and general fraying of elastic tissue in aortae begin to take place much before any significantly discernible sudanophilia of aortic intima. This is accompanied by decreased plasmal reaction and decreased unsaturated fatty acids in the thin film of lipids adhering to the surface of the elastic fibres, decreased phospholipids, increased calcium deposition in aortic intima and increased metachromasia. Colesterol deposition begins to set in after more prolonged experimental condition. It is concluded that the change in the patterns of elastic behaviour may play some role in bringing about the lipid deposition in the experimental animals.

52. Changes in the Cytoplasmic Constituents of Liver after Carbon Tetrachloride Intoxication.—A Histochemical Study.

B. CHAKRAVARTY and C. DEB, Calcutta.

An extensive fatty degeneration in liver has been observed after carbon tetrachloride poisoning in rats. In the present investigation, changes in the different histochemically demonstrable cytoplasmic constituents under such condition have been studied.

A disturbed carbohydrate metabolism has been observed after intraperitoneal injection of carbon tetrachloride. This is concluded from the observation of high fasting blood sugar and reduced glycogen content of liver. Along with this there was a fall in both succinic dehydrogenase and glucose-6-phosphatase. No abnormality was however been observed in the Islets of Langerhans of pancreas. External injection of insulin caused a fall in blood sugar level like normal animals. It has been suggested previously that the high neutral lipid observed in the liver is formed from carbohydrate. Rise in plasmalogen observed in the liver of treated rats was due to this conversion of carbohydrate to fat. An inverse relationship as regards the distribution of different enzymes has been noted in the damaged liver. Hepatic area containing very high neutral lipid was practically devoid of any enzymatic activity. In the region of undamaged cells higher amounts of acid and alkaline phosphatase were however present. This unaffected portion also showed higher amount of α-amino acids and R.N.A.; but not the fatty region. There was a rise in D.N.A. content in the intoxicated liver.

53. Succinic Dehydrogenase and Esterase Distribution in Toad (Bufo Melanostictus).

MRITYUNJOY MUKHERJI and CHANDICHARAN DEB, Calcutta.

Succinic dehydrogenase and esterase have been studied histochemically in different tissues of toad in hibernation and non-hibernation.

Very high amount of succinic dehydrogenase was observed in the liver of toad during April. During August, succinic dehydrogenase content of liver was found to be low, which declined further during pre-hibernation and the hibernation periods. The esterase content of liver was found to remain almost unchanged throughout the year. Very little decline in succinic dehydrogenase contents of heart and muscle was observed during hibernation. Decline in intestinal succinic dehydrogenase has been related to the decline in intestinal activity during hibernation. No change in the esterase content of the intestine was observed. A small decline of both the enzymes in kidney as observed during hibernation is probably due to little alteration in kidney function during hibernation. Non-secretory accumulation of esterase in the acinar cells of pancreas has been observed during hibernation.

The possible relationship of the levels of dehydrogenase activity in various issues during hibernation and non-hibernation with carbohydrate metabolism has been discussed.

PHARMACOLOGY

54. Action of Chaksine Chloride on Respiratory and Cardiovascular System.

M. L. CHATTERJEE and C. D. DEY, Calcutta.

Chaksine is an alkaloid isolated from the seeds of *Cassia absus*.

Chaksine chloride has been observed to stimulate respiration with lower doses and to depress with higher dose. However, the tolerance varies in different species of animals. The drug exerts its action at least partially influencing the respiratory centre proper. The alkaloid produces a sustained fall of blood pressure in anaesthatised animals which remains unaffected after vagotomy, atropinisation or in decerebrate preparation, but the fall is reduced in spinal animal indicating a central site of action. The hypotensive effect is also reduced partly after pendiomide and the rest of the fall can be blocked by heavy dose of anti-histaminics. Moreover, the drug shows anti-nicotinic actions on B.P. and isolated heart and peripheral ganglian blocking actions.

Thus the mechanism of fall of blood pressure by the drug appears to be a complex one. Partly it is due to ganglian blocking action and partly due to histamine like effect.

55. Effect of a few Compounds on Blood Sugar Level and Catecholamine Content of Adrenal Glands of Cats.

M. L. CHATTERJEE and M. S. DE, Calcutta.

An anti-histaminic agent promethazine, a tranquilizer triflupromazine, an adrenolytic agent dihydroergotamine and an anti-hypertensive agent guanethidine were tested for their effects on blood sugar level and adrenal catecholamine content f anaesthetised cats. It was seen that the anti-histaminic agent promethazine, which has slight catecholamine-releasing effect produces slight fall in the blood sugar level. The tranquilizer triflupromazine and the adrenolytic agent dihydroergotamine having no catecholamine releasing effect lower the blood sugar level o a greater degree, dihydroergotamine being most effective of the three. The antihypertensive agent guanethidine which is a sympathetic blocker, without any adrenolytic effect releases some amount of catecholamines from adrenal glands and raises the blood sugar level. These as well as our earlier observations suggest that it may be misleading to presume or predict what will be the effect of an agent on blood sugar level merely from the fact of release or not of catecholamines from adrenal glands.

56. Search for Potent Hypoglycaemic Agents, Part III. Mode of Action With Special Reference to Biguanides.

A. N. BOSE and S. P. PAUL, Calcutta.

The mode of action of the synthetic hypoglycaemic agents is yet far from clear. Biguanides studied in comparison to tolbutamide and insulin revealed that biguanides in general cause depletion of liver and muscle glycogen and increase plasma inorganic phosphorus level in fasted guineapigs, whereas insulin and tolbutamide exert reverse effect. To have an insight into the reason behind this anomalous effect of different hypoglycaemic agents the effects of the biguanides (Ad_2, Ad_3 and Ad_4 or benzyl, α-phenethyl, β-phenethyl biguanides respectively), tolbutamide and insulin on liver and muscle glycogen content and on plasma inorganic phosphorus level after a high glucose load were investigated.

Results indicate that amongst the biguanides, Ad_2 treated animals show a depletion of liver glycogen even when the blood glucose is normal, whereas in Ad_3 and Ad_4 treated animals, this remains practically unaltered. Muscle glycogen values show slight increase or remain unaffected with biguanides after glucose load. In insulin and tolbutamide treated groups however, both muscle and liver glycogen is found to be increased with the same load. With regard to plasma inorganic phosphorus it is significant to note that while insulin and tolbutamide cause hypophosphatemia, biguanides in general, produce a rise in plasma inorganic phosphorus which is more pronounced in Ad_2 treated groups.

57. A Study of the Action of Reserpine (Serpasil) on the Hypothalamus.

S. R. DASGUPTA and R. C. MAZUMDER, Calcutta.

Lymphocytopenia following emotional stress in normal rabbits is one of the most rapid indicator of anterior pituitary activity. This anterior pituitary activity, however, is under hypothalamic control. Any effect of reserpine on lymphocytopenia of stress, then, might also be interpreted as an action on the hypothalamous, and the present work was, therefore, undertaken.

Blood was collected in control experiments directly from rabbit's ear vein before and after subcutaneous faradic shocks. Next, after drawing the blood sample, reserpine (Serpasil) was administered, intramuscularly to the rabbit. After about an hour or so when the animal was visibly under the influence of the drug, faradic shock was given subcutaneously. Blood was again collected 3½ hours after the application of stress.

The common finding was that, 3½ hours after the stress the blood count showed (1) a rise in total W.B.C., (2) a rise in neutrophils and (3) a definite fall in lymphocytes. The significant finding, however, was, whereas in the control experiments the lymphocytopenia was only relative and not absolute, the lymphocytopenia after the administration of drug and stress was not only marked but absolute.

This showed that not only reserpine did not have any inhibitory effect on the ACTH liberation by the hypothalamus, but also that it appeared to stimulate it. The significance of these findings have been discussed.

58. Effect of Exposure to Cold on Blood Glucose Level in Men.

B. S. KAHALI and K. P. KHUTETA, Jaipur.

Effect of exposure to cold on blood glucose level has been studied in men. The subjects were exposed to cold and arterial blood level of glucose was determined. Blood glucose level showed a significant rise. The possible mechanism of this hyperglycaemia has been further investigated by simultaneous determination of blood potassium and adrenaline. All subjects showed a varying rise of blood potassium and adrenaline. Hyperglycaemia in cold stress is possibly produced by increased glycogenolysis due to the "emergency discharge of adrenaline", which occurs in all kinds of stress situations. Hyperkalaemia observed in these subjects is partly due to increased glycogenolysis in liver and other tissues and partly due to catabolic effect of glucocorticoids liberated during stress.

59. Studies on Acute Toxicity of Glucose Cycloacetoacetate and its Hydrolysed Product.

A. K. DORLE and M. C. NATH, Nagpur.

The oral and intraperitoneal acute toxicity of Glucose Cycloacetoacetate (GCA) and the product obtained by its hydrolysis with HCl (GCA-hydrolysate) which is known to contain 1 :2 dienol glucose has been studied in mice. The oral administration of GCA and GCA-hydrolysate is found to be absolutely non-toxic. Intraperitoneal administration of GCA even to the extent of 750 mg./100 g. body wt. is non-fatal. GCA-hydrolysate in the doses up to 250 mg. equivalent/100 g. body wt. is absolutely non-toxic. LD_{50} of GCA hydrolysate is calculated to be 600 mg. equivalent/100 g. body wt.

60. Studies on Synthetic Antispasmodics: Part IV.

SRIPATI BOSE and A. N. BOSE, Calcutta.

It has already been communicated that while searching for newer antispasmodics in the β-amino ketone series, some of the compounds, i.e. (4-phenyl-4-benzylidine-1-piperidine-butan-3-one hydrochloride)—C_1; and (4-phenyl-4-benzyl-1-piperidino-butan-3-one hydrochloride)—C_2, showed some cardiac stimulation. While working to explore the degree of such activity, some newer characteristics of the compound C_2 on toad heart were noticed.

(i) The heart could be made to tolerate a much higher concentration of the drug when administered in gradual doses.

(ii) With each washing away of the drug, the heart was found to attain a stimulatory phase following an initial state of depression.

The first point is possibly due to, the heart developing a tolerance towards the compound, similar to the development of tachyphylaxis in vasomotor reaction. The second point may possibly be due to the fact observed with some other amino ketones that the drug in minute traces produces an increased contractibility of the heart muscle and a prolonged diastolic pause.

61. Safety Index of Ether, Chloroform, Trichlorethylene and Halothane in Mice, Rats and Guineapigs.

M. N. GHOSH, R. K. SRIVASTAVA and A. K. GHOSH, Kanpur.

An apparatus has been devised for testing margins of safety of volatile anaesthetics on small laboratory animals like mice, rats and guineapigs. With the help of this apparatus the individual anaesthetic dose (IAD) as well as the individual fatal dose (IFD) are measured in each animal and the "safety index" calculated as the ratio IFD/IAD. Reproducible results are obtained with only 5 animals.

A comparative study has been made with ether, chloroform, trichloro-ethylene and halothane on mice, rats and guineapigs. With exception of trichloroethylene, ether appears to be the safest of all the anaesthetics tested. Chloroform and halothane have almost equal margin of safety. In contrast to ether and chloroform, halothane gives fairly constant "safety index" in all the three species of animals tested. There is no significant difference between the "safety index" of chloroform in young and adult of mice, rats and guineapigs.

62. Studies on mode of Action of Alkaloids Employing Lactic Acid Bacteria.

S. K. PAIN and B. N. DUTTA, Calcutta.

Administration of chemotherapeutic drugs to human patients produces undesirable side effects like vitamin deficiency and manifestations of toxic symptoms. The present study was undertaken to observe the toxic effects of alkaloids like morphine, atropine, quinine, pethidine, strychnine, caffeine, codeine, emetine and papavarine on lactic acid bacteria grown in vitamin assay media enriched with the particular vitamin to be assayed for optimum growth. *Lactobacillus casei ATCC 7469* was grown in media for folic acid and riboflavin, *Lactobacillus arabinosus 17-5,* in media for niacinamide and *Lactobacillus leichmannii ATCC 7830* in media for Vitamin B_{12}.

The maximum non-inhibitory concentration, the concentrations of the alkaloids to produce 50 per cent inhibition of the maximum growth for the organisms mentioned above were determined. Quinine, strychnine, pethidine and emetine exert maximum inhibitory effects while atropine, caffeine and codeine are practically inactive or partially inhibitory in very high concentrations. In the light of the data obtained the former group of alkaloids may be classified as inhibitory, while the others as partially inhibitory or inactive. In general, most of the drugs are relatively more toxic for *L. leichmannii* than for *L. arabinosus* and *L. casei.* Aside from the possible practical application of these findings in nutrition, however, such drug-vitamin studies may help elucidate the mechanism of action of alkaloids in biological systems.

63. Study of some Heterocyclic Compounds for Anti-Helminthic Action.

J. K. MOHANTY and B. N. DAS, Burla.

Fourteen heterocyclic compounds which are either rhodanins or benzothiazoles were studied *in vitro* for possible anti-helminthic property by using preparations of *Ascaris lumbricoides* and *Pheretima posthuma.* Out of these only two compounds exhibited significant anti-helminthic activity under the experimental conditions. Chemically both the active compounds are benzothiazole derivatives. The results of this investigation most probably warrant further study of the two active compounds and screening of newer benzothiazole derivatives for anti-helminthic action.

64. Anti-Bacterial Activity of some Thiazole Derivatives.

J. K. MOHANTY and B. N. DAS, Burla.

Sixteen newly synthesized heterocyclic compounds were studied for possible anti-bacterial activity. Initial screening tests were carried out by modified hole-plate method using *Micrococcus pyogenes var. aureus* as the test organism. Compounds, which by this method were found to exhibit significant anti-bacterial activity, were further tested by serial dilution method for quantitative estimation of their potency. Only four compounds of this series were found to have bacteriostatic property. Study of structure-activity relationship of the compounds of this series reveals that all four compounds found active belong to the group 2-amino-5-sulphonamide-thiazole. As such the compounds of this group are thiazole analogues of (p)-amino-benzene-sulphonamide. Of the four active compounds M-99-BB (code number) was the most potent. Examination of its structure shows that it is isosteric with (p)-amino-benzene-sulphonamide. The effect of various radicals when introduced in position-4 of the thiazole ring on anti-bacterial activity has been discussed.

MISCELLANEOUS

Separation of Amino Acids by Asbestos Chromatography.

B. N. SEN and N. B. CHATTERJEE, Burdwan.

The technique of the asbestos chromatography originally developed for the timation of inorganic ions in mixtures has been extended here to the separation the few amino acids. The separation of the mixture seems to be quite effective d reproducible. The whole method is comparatively simple and less time-nsuming.

SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

President :—Dr. G. D. Boaz, M.A., D.Phil. (Oxon.)

Abstracts

GENERAL

1. The Role of Psychologists in the National Development of India.

S. V. KALE, Bombay.

With limited resources at our disposal and vast strides yet to be taken, Ind
has no other alternative but to adopt a system of planned national developme
If the allotments in the third Five Year Plan are scrutinised, one finds about 24
outlay for what may be termed expenditure on *'psychological sector'* which co
prises education, social and labour welfare, community development, health, hou
ing, rehabilitation etc. A detailed inventory is made in this paper of the differe
"ad hoc" opportunities of national service as well as professional and person
advancement that exist for psychologists in the present set-up of the executio
of the Third Five Year Plan. However, these opportunities have not been pr
perly transformed into clearly perceived and accepted 'roles' of psychologists
national and social development. The psychologist may have to hold himself re
ponsible for this situation, because maximum use of the independent recognitio
that psychology won as a science in India some three or four decades ago has n
been made. Even now, the psychologist is in a position to recover the lost groun
by making contributions towards the scientific understanding of the various barrie
in our national development. Problems like individual's general attitude to li
and work, in India, or communal, regional and language factors in national inte
gration await research-oriented answers. The psychologists also owe it to th
nation to try for a nation-wide acceptance of testing procedures, at various ed
cational levels, and for a nation-wide use of the results of test-data for the asses
ment of qualified human potential in various professions. The role of psycholo
gists, far from being a static conception, needs continuous evaluation.

2. Right approach to emotional integration.

K. K. PANIKAR, Poona.

How to bring about emotional integration on a national level poses to be
difficult problem for the political leaders of the present—Emotional Integratio
Committee appointed by Government of India under Ministry of Education is i
evidence for the same—general feeling that emotional disintegration was no
evident—at least as evident as at present—before Independence—need—prope
understanding of the expression—'emotional integration'—'emotional integration
as integration of right type of feelings about situations in life with a strong reac
tion to act rightly upon them. Levels of emotional integration : (1) Home
(2) School including University and (3) National.

The process of emotional integration—influence of the working natural socia
tendencies viz., imitation, suggestion and sympathy. Their influence at home
school and society. The main factors that are causing this disintegration—emo
tional integration or disintegration has a tendency to flow from the elders to th
young. How far are the parents and the teachers responsible for this integration—

at is the place of the politicians in the process of this disintegration—Right ginning from the top above—Education dominated by politics—Education of poliians by politicians will be the right approach—When can teachers properly help s integration? After they are free from economic and political domination.

What is Vedic Culture?

K. A. PATWARDHAN, Indore.

The paper starts by explaining that the Vedic or Bharateeya culture has been eated by the inhabitants of Bharatvarsha, who are the followers of the path of ght or knowledge determined, shown and prescribed by the Vedas. Later on an tempt has been made to show that the Vedic Mantras or Aphorisms covered pracally all the branches of knowledge of mind and matter in its perfect and unterable form and taking full advantage of their knowledge of the Universe and the evolution of the human body as the final product of organic evolution, the edic sages established the theory that the body of a living human being is an niverse in miniature while the Universe could be said to be a highly magnified man body. On the basis of this theory the new social structure which the Vedic vants created, was so framed that it was a man made replica of a human body d hence also of the Universe. Such a social order, which promoted cultural eation, being based on perfectly scientific footing, gave birth to the civilization nown to be existing in the world as Vedic 'Sanskriti' or Vedic Culture.

EXPERIMENTAL PSYCHOLOGY

. Experimental Study of Individual Preferences for Two Colour and Three Colour Designs.

K. N. SHARMA, Calcutta.

The problem of differences in individual preferences is attracting the attention psychologists more and more. The present investigation was undertaken as an tempt to study one aspect of individual preferences, *i.e.*, to study the factors sponsible for the difference in the preferences for colour-combinations. For the perimental and analytical procedure the multidimensional method of successive tervals was employed. As a result of factor analysis, three factors were extracted hich seem to affect the individual preferences. The factors have been interpreted : (1) Number of colours used in the combinations, (2) Principle of Proximity; nd (3) Principle of Closure.

. Study of Colour Preferences in Subjects Ranging from 4 to 45 Years Age.

P. KRISHNAMURTHY and P. NATRAJ, Mysore.

A number of studies on colour preferences were carried out by Western Psychoogists on whites as well as other races to investigate the effects of culture, age, ex and education on colour preference.

The present investigation on a section of Indian population was undertaken to tudy primarily the influence of age and to provide comparative norms.

Six major colours Red, Green, Blue, Yellow, Orange and Violet were used to tudy the preferences in 1255 female subjects ranging in age from 4 to 45 years rawn from Mysore city. The rank ordered data from each age group was transormed into scale values following Guilford's composite standard method.

The general trend is that Blue, Green and Red are preferred most while Yellow and Violet are least preferred.

Neither any marked group tendency in each age group, nor any orderly shift in colour preference with progress in age is evidenced.

At the lower age ranges, the differential preference for colours is low; and with age the differential preference increases.

The final rank order of colours, ignoring the age, resembles closely the rank orders for colours given by whites.

6. The influence of meaningfulness of stimulus and response members in Paired Associate Learning.

V. K. KOTHURKAR, Poona.

This is a report of an experiment in which an attempt has been made to investigate the relative influence of the meaningfulness of the stimulus and response members in paired associate learning. The following experiment was based on the hypothesis that meaningfulness of the response member has greater facilitative effect on paired associate learning.

METHOD

Four paired associate lists each consisting of 10 pairs drawn from Nobles' (1952) list of dissyllabic nouns and paralogs calibrated for meaning (m), constituted the materials of this experiment. High-High, Low-High, High-Low and Low-Low lists were constructed by appropriate combinations of the scaled dissyllables and paralogs.

Not only the acquisition but also the retention aspect of learning was investigated in this experiment. Generally, in exploring difficulty—meaning relationship experiments are designed with attention to mere acquisition of verbal materials. Instead of assuming that similar relationships would obtain in retention as well, an attempt was made to study the aspect of retention experimentally.

RESULTS

(*a*) *Learning*:—The mean learning scores for the four principal experimental groups were 10·85, 12·55, 14·13 and 33·70 for High-High, Low-High, High-Low and Low-Low lists respectively. The results clearly show—an increasing rank order of difficulty for the HH, LH, HL and LL lists. Of the two experimental conditions, Low-High and High-Low, the one with high meaningfulness of response is easier—and the other with low meaningfulness of response member is more difficult.

(*b*) *Retention*:—The mean recall scores (number of items recalled) of the four experimental groups were: 8·98 (Low-High); 7·95 (High-High); 7·48 (High-Low) and 6·99 (Low-Low). It is important to note that in respect of retention (recall) the experimental condition Low-High scores an advantage not only over its reverse condition High-Low but also over the condition (High-High).

Statistical Analysis of Variance and tests of statistical significance are given. Results and discussion bear out the original hypothesis.

7. Influence of controlled time gap on estimation of duration.

R. G. CHATTERJEA and G. B. SAHA, Calcutta.

An attempt is made in this paper to show that in a controlled time gap (T.G.) the trend of the estimation would be different from the one's where T.G. was uncontrolled. The estimation in this case would then be all over-estimates, Three sets of data were obtained—where set I and set II were in ascending and escending orders of presentation respectively. The time gap in this case was the ame as the stimulus times. In set III the presentation of stimulus times was aphazard and the T.G. was controlled by the experimentor. In that the observers were required to sit quietly for a considerable amount of time to hear the signal.

In the result it was found that all the stimulus times were over-estimated in hree experimental sets. The trends of the estimations showed a regular rise along with the rise in the stimulus times but the constant error (C.E.) values were great.

Depth Perceptions: I. Practice-effect and II. Effect of rod-width on distance discrimination.

ARUN K. SIRKAR, Calcutta.

The present work, a part of the proposed intensive study on distance discrimination, has been designed to note the practice-effect and the change in the judgments with the variation of rod-width in a modified Howard-Dolman apparatus. The results indicate a small change due to practice, though statistically insignificant and reveal some unusual phenomena contrary to the past researchers' contentions in regard to the effectivity of the changing rod-width.

9. Two-choice learning in children and adolescents under rewarded and non-rewarded conditions.

J. P. DAS and K. C. PANDA, Cuttack.

This study investigated the effects of age differences as well as the presence or absence of a material reward on two-choice learning where E_1 and E_2 had probabilities of ·75 and ·25 respectively. An equal number of children and adolescents were divided into 8 groups of 17 *S*s each, corresponding to the 8 experimental levels. The other variable was picture and non-picture stimulus cards. Learning was quick and at the end of 100 trials, reached a level higher than the usual 75 per cent asymptotic level. Reward seemed to affect learning adversely in the initial stages, but was responsible for a steeper learning curve as indicated by a significant *F* for trend. Children predicted E_1 oftener than adolescents in the earlier trials. Likewise, pictures were predicted more often than non-pictures in the initial trials. It was suggested that reinforcement would act as a distractor if it can convey adequate information about the learning task.

10. Nature of the error ratio curve in a psychophysical experiment.

AMAL KUMAR MALLICK, Calcutta.

The error ratio is defined as the ratio of the differences between the subjective judgment of a stimulus in the fractionation method and the judgment expected, to the expected judgment. Error ratio values obtained in a psychophysical experiment on half-angle judgment for angles between 1° to 359° are plotted against the expected judgment values. The statistical curve roughly conform to the mathematical curve represented by the equation, $y = -ae - {}^{-bx}\text{Sin}3x$. The periodicity is not strictly speaking regular, as in the mathematical curve, the amplitude ae^{-bx} decreases with the increase of x.

A detailed study of the curve is in progress.

11. Influence of colour on weight-judgment.

AMARENDRA NATH BANERJEA, Calcutta.

The investigation was aimed at determining the influence of colour, if any, o the comparative judgments of weights for a given series of objects.

Wooden cubes of identical sizes and weights (physical) but of different colour were used as materials for the study. Twenty high-school pupils (ten boys an ten girls) of the age range 14 to 16, and having normal visions (chromatic an achromatic) comprised the group of subjects.

In the experiment (conducted individually) the subjects were asked to assig relative weights for each of the cubes presented as (i) a series of six colours (fou chromatic and two achromatic) and (ii) a series of four primary colours (chromatic) The conditions of presentation (for each series) enabled the subjects to form thei judgments by (a) visual, (b) visuo-tactual and (c) tactual (having tied eyes) perceptions of the objects—thus permitting the colours to influence judgments in the first two presentations only.

The resulting data, when analysed, suggested the following conclusions :

(1) Weights assigned to different objects were definitely influenced by their specific colours.

(2) In the series of six colours, the black gave the impression of the heaviest and the white the lightest.

(3) In the series of four primary colours, the corresponding impressions shifted respectively to the blue and the yellow.

(4) Tendency to associate weight with colour was found to be independent of the sex-differences.

12. Complexity—Simplicity dimension and the perceptual preference pattern of the Musician and Non-Musician: A Comparative study.

MANAS RAYCHAUDHURI, Calcutta.

The capacity to tolerate ambiguity and a tendency to prefer complex stimulus material in the perceptual field have long been recognised as possible variables in the personality of the artists. Eysenck also suggested of a bipolar factor of 'simplicity—complexity' for polygon preferences. Recently a systematic and objective method of measuring these variables have been suggested by Barron and Welsh, who have constructed a figure preference test (WFPT) consisting of a set of black and white figures that significantly differentiate Artists from Non-Artists in terms of their preference dichotomy. The stimulus figures of the test, underlying 'complexity—simplicity' dimension, range from simple geometric forms to complex and diverse patterns and designs. Raychaudhuri in an earlier paper has reported that the Art scale of WFPT could be used successfully in differentiating Artists from Non-Artists in Indian population.

The purpose of the present research is to see whether Musicians who work in a different medium and with different tool from the painting-Artists do equally well in Art scale of the WFPT. The two hypotheses tested are :

(*i*) that the musicians differ significantly in their Art scale scores from the scores of the non-artists, non-musicians and

(*ii*) that the musicians do not differ significantly in their scores from that of the scores of the painting artists.

The Barron-Welsh Revised Art scale (RA) is applied to three groups—(i) Experimental Group consisting of 30 professional musicians, (ii) control group I consisting of 50 individuals engaged in Non-musical, nonartistic professions and (iii) control Group II consisting of 60 senior students of fine Arts-painting. The mean scores of the Musician and Non-Musician group are 29·00 and 19·90 respectively. This mean difference gives a 't' of 4·57 which is significant at ·01 level of confidence.

The mean scores of the Musician and Fine Art-Painting group are 29·00 and 0·83 respectively. This mean difference gives a 't' of 5·28 which is significant at 01 level of confidence. If we do not disregard this difference as due to sampling rrors we may assume that painting artists professionally develop a greater capaity to tolerate complex visual stimulus material than the musicians. Musicians hough possess greater capacities than the non-artists in this dimension do not levelop it to the extent as the painting-artists do, which may be due to the musicians' concentration in auditory sense-area.

TESTING AND MEASUREMENT

13. A comparative study of 'Intelligence Scores' by *Rural* and *Urban* school children.

S. JALOTA, Punjab.

There are several reports of intelligence test scores by groups of rural and urban children in other countries. This paper presents a critical comparative study of results obtained in India with 'spiral omnibus type verbal group tests' in Hindi and Panjabi. In general the urban children seem to have a significant advantage; that is noticed in the mean total scores. But there is no significant difference among the elements, specially of 'number series' and of 'reasoning'.

14. A preliminary study of a set of ink-blots.

B. KUPPUSWAMI and H. S. ESWARA, Mysore.

Long ago Whipple standardized 20 ink-blots to gauge the fertility of visual imagination.

The present paper reports an attempt to standardize a set of ink-blots to study the spontaneous imagery and creative thinking among school students.

To start with, 40 ink-blots varying in size and complexity were prepared, 20 being bilaterally symmetrical and 20 odd-shaped. Children ranging in age from 9 to 15 of the middle and high school classes were given these blots in small groups in two sessions. On the basis of the total number of responses and number of different responses 10 cards were selected. These cards were given to a sample of 60 children of age groups 13, 14 and 15 of both sexes studying in IX standard.

It was found that boys gave larger number of responses than girls but the difference between the means was not significant. Similarly with increase in age there is increase in number of responses; but these differences also were not significant.

It is proposed to extend the study and standardize the test.

15. Effect of practice on test scores.

MANJULA MUKERJEE, Calcutta.

The objective of this study was to test whether previous experience of a similar test had any effect on the scores of the test taken afterwards.

The scores of three pairs of tests conducted over three different groups o persons were analysed. It was found in all the three samples studied that practic had some effect on test scores and this effect was significant statistically.

16. Validation of Madras Picture Frustration Study (MP-F). through Trend Analysis.

B. C. MUTHAYYA, Madras.

An attempt was made to verify the interpretative assumptions through investigation of the internal consistency of the MP-F by trend analysis. It was hypothesised that if an individual has built up stable and adequate patterns of reaction to frustration, he will meet each situation in its own setting and will react to it in an appropriate manner without the interference of residuals from his previous behaviour. If on the other hand, his reactions are unstable, perhaps an expression of conflict, his behaviour in a later situation may represent a compensation for or a reaction against his previous response. Thus it was assumed that protocols showing trends reveal less extra-punitive reaction than protocols without trends. In order to verify this assumptions, a trend analysis of 50 protocols of the MP-F was made in order to discover protocols with trends and without trends. While deciding the significance of the trends, Rosenzweig's tentative standards of significance were made useful. Means were calculated for the Extrapunitive reaction for the groups, with trends and without trends and the critical ratio between the Means was found out. The results, though not significant, revealed that the group showing trends in the MP-F records expressed less Extrapunitive reaction that those without trends verifying the hypothesis that the appearance of trends is an indication of unstability and conflict in the expression of aggression. The results suggest the feasibility of this validational procedure particularly to controlled projective techniques like picture frustration study.

17. A Comparative Study of Psychological Scaling Methods.

R. K. MISRA and P. K. DUTT, Lucknow.

A comparative study was made of the methods of paired comparisons and rank order. One hundred University students were asked to express their preferences for ten vocations both by the methods of paired comparisons and rank order. The rho (co-efficient of correlation from rank differences) for rank values of the items scaled by the two methods was ·90. A linear curve was obtained when the rank values for the two methods were plotted on graph. It is suggested that the rank order method might be taken as a moderately good substitute for the method of paired comparisons provided that the number of items to be scaled does not exceed fifteen or so.

18. Form of Bengali language as a determinant of ideas contained in the items of a foreign personality inventory.

DEBABRATA BANERJEE and AMAL KUMAR MALLICK, Calcutta.

This paper reports the first part of a study involving the effect of two forms of Bengali language, 'chaste' and 'colloquial', on the ideas of meanings of verbal test-items.

In this part of the experiment 12 judges (students and degree-holders), both male and female, were asked to rate 12 statements of H. J. Eysenck's 'A Short Questionnaire for the Measurement of Two Dimensions of Personality', translated in two forms of Bengali language (chaste and colloquial). The judges were to rate each of these items on a 5-point qualitative scale of 'satisfactoriness'—the criterion of satisfaction being the effectiveness in the expression of ideas contained in the original statements.

After testing the reliability of the judgments offered by each of the judges, the results were quantified and the average values for each statement of the two forms were worked out. The different values (average) thus obtained for the different groups of judges—(male-female and student-degree-holders) were subjected to correlational analysis.

The high values of correlation (all above +·90) indicated very close relationships between the judgments of different groups as to the nature of satisfactoriness in the expression of the ideas carried by the original version (English) of the test. This suggests that so far as the present group of judges are concerned there is no appreciable difference in meaning for the two forms (colloquial and chaste) of the Questionnaire.

The investigation, however, awaits a final conclusion, after the results of the use of these two forms on a group of pupils of lower age are available to the authors.

19. A study of relationship between test scores and achievements in some school subjects.

RAMANATH KUNDU, Calcutta.

The paper presents the results of a study carried out to determine the relationship between test scores and achievements in some school subjects. Two tests, one to determine intelligence quotient and the other to assess concrete intelligence, were administered on a group of 70 students of a Calcutta school. The marks obtained by the students in different linguistic subjects such as English, Bengali, etc. were collected from the school record.

Significant positive correlations between intelligence quotient and marks obtained in languages indicated that attainment in language is sufficiently related to abstract intelligence. So the scores of abstract intelligence test could be regarded as predictor of success in learning languages. The concrete intelligence test was found to be not suitable for the same purpose.

The findings of the study suggested that elaborate investigation in this line is worth attempting. The usefulness of the two tests for predicting success in some specific subjects could also be investigated.

20. Psychological tests in the selection of M.S.W. Students.

S. DUBE, Baroda.

A pilot study was conducted to verify how far the Psychological tests are helpful in the selection programme of the Faculty of Social Work of Baroda University. A brief summary of the psychological testing is presented to emphasize the role of the testing in the selection of the trainees for the general training of Social Work at post graduate level. The selection criteria (specified in terms of 11 Social Work Potentials) and the test battery is discusstd at length.

Correlation was made on a five point Rating Scale between the assessment of social work potentials of 24 students (1959-61 batch) by selection test, retest and the judgement of their supervisors at the end of the training of two years. All the correlations are positive but varying in importance from ·1 to ·9 in the assessment of different potentials. Suggestions are made for further carrying this investigation, for evolving a common frame of reference for the Raters and validating the presennt Test battery with other external criterion.

21. Differential weighting of linear-transformed scores according to the difficulty levels of test items.

SUSHIL KUMAR, Calcutta.

In tht linear transformation of scores (X or Z) equal weight is given for equal differences in raw scores (The differences between z scores of 30 and 60; and 60 and 90, will be the same). Although in many cases it is not the best estimate of the ability. It is suggested in this paper that we divide the test in three parts according to the range of the difficulty of items e.g. $p \geqslant 0{\cdot}70$, $p \leqslant 0{\cdot}30$, and $0{\cdot}30 < p < 0{\cdot}70$. We compute mean and standard deviation of each part and compute z not by the formula.

$$\frac{Xi - X}{\delta}$$

where X and δ are the mean and standard deviation of the total score. And X_i is the raw score of ith individual but by $\frac{\Sigma Z_i}{\delta_z}$ where δ is the standard deviation of the distribution

$$\Sigma Z_i = Z_{Ai} + Z_{Bi} + Z_{ci}$$

A, B and C are the three parts of the test. A short method of compulting $\frac{\Sigma Z}{\delta_z}$ or Z-score is also given.

22. Estimation of reliability of the mean of artists' ratings on their quality for purpose of potential-artist-selection scheme.

PRYANSHU SEKHAR BHATTACHARJEE, Calcutta.

Qualities selected by the 50 expert artists for successful operation and control to become a painter have been subjected to ratings by exponents in the line of art. Three such exponents rated the required qualities in a five point scale has stood for a statistical estimation of reliability of the same. Robert. L. Ebel's method of ascertaining rating-reliability has been accepted in this survey.

Variances of traits and errors have been estimated to be 1·784 and ·573 respectively with 11 and 22 degrees of freedom. The r_{11} has been found ·413 which is satisfactory and has been accepted.

23. Construction of a psychological scale of thickness.

AMAL KUMAR MALLICK, Calcutta.

An experiment on subjective thickness has been performed for constructing a psychological scale of thickness. Data have been collected for the thickness of 1·25, 3·75, 6·25, 10·00, 12·50, 15·00 and 18·75 mm. Inter-judgment differences due to the feeling of thickness with righthand and lefthand are not statistically significant.

The thickness of 4·96 mm. is found to be judged as half of the thickness of 10 mm. This subjective thickness corresponding to a physical thickness of 10 mm. is taken as the unit and is termed as 1 Dicke. Similarly the subjective thickness corresponding to the physical thickness of 4·96 mm. is regarded as half Dicke. Thus a scale of psychological thickness has been constructed. The functional relation between the physical and psychological scales have been determined both graphically and analytically. Some empirical equations relating the physical thickness in mm. to the psychological thickness in Dicke has also been deduced.

24. Relation between Kuder Preference Record and a Non-verbal Interest Inventory modelled after it to suit Indian conditions.

S. CHATTERJEE and MANJULA MUKERJEE, Calcutta.

The paper discusses a study of the relation between the scores obtained on Kuder Preference Record (vocational) and Chatterji's Preference Record—a non-verbal interest inventory modelled to some extent after the former inventory. Product moment correlations were calculated between the comparable scales. The results are discussed in the paper.

25. Stability of measured interests.

S. CHATTERJI and MANJULA MUKERJEE, Calcutta.

The Kuder Preference Record and a non-verbal interest inventory (CPR—1158) was administered to a group of 23 freshmen. After one year when these students were in the second year of their training the testing was repeated. Correlations between initial and final scores were computed in order to determine stability of measured interest under the influence of the training imparted and the passage of time. Generally it could be said that stability is quite high in those fields which are directly connected with the training during the intervening period.

26. An experimental study of interviewer bias.

A. S. PATEL, Baroda.

The present investigation has been undertaken with a view to studying experimentally in an interview process the bias effect resulting from some peculiar characteristics of the interviewer, e.g., influence of sex, training, and communalism of the interviewer as well as his knowledge about the status of the interviewee. Hundred interviewers were sampled for this purpose in such a way that half the number were men and half number women, half experienced teachers and half fresh graduates, half number Gujaratis and remaining half Maharashtrians; one half number of interviewers were supplied with particulars regarding the status of interviewees and the other half did not have any knowledge about the interviewees. Sixteen high school pupils—both boys and girls, Gujaratis and Maharashtrians—served as interviewees to be interviewed on a specially prepared general knowledge test. Each interviewee was specifically and differently tutored beforehand regarding the answers to the questions in the test so that the score to be obtained by each was objectively fixed.

The statistical analysis of the interviewees' performances assessed by the interviewers revealed the following interesting findings :—

(1) Thre was a very high extent of subjective bias of interviewers in judging even most objective data.

(2) There were significant sex differences as well as community differences, but no training differences in judgment.

(3) Significant differences were also observed in assessment when the interviewer of one sex or one community evaluated the performance of interviewees of same and different sex or community.

(4) There were also significant differences in judgment when the interviewers had and had not knowledge about the status of the interviewees.

PERSONALITY

27. An experimental study of the relation between temperamental factors and attitudes.

E. I. GEORGE, Kerala.

The work reported in this paper is an investigation of the possible relation between social attitudes, interests and personality traits. These were tested by means of the public opinion inventory of Eysenck and Melvin, the Allport Vernon study of values, and Guildford's inventory of personality factors. The sample consisted of 500 British middle class people. The scores were treated by means of factor analysis, analysis of variance and item analysis.

Four orthogonal centroid factors were extracted after rotation identified as follows: I. Tough mindedness—tender mindedness, II. Neuroticism, III. Radicalism —conservatism and IV. Extroversion—introversion.

Analysis of variance yielded significant differences between groups of political parties, between radicalism-conservatism, but not on the tough-mindedness—tendermindedness and on all the interest categories except the political value.

Analysis of items measuring toughmindedness—tendermindedness and extroversion—introversion indicated that there was a positive relationship between these two variables.

28. Differential Ideal Self Image of Engineering Students.

H. K. MISRA, Kharagpur.

High and Low achievers of an Engineering Institution were asked to rate each of 45 personality traits on an 8 point scale for their relevance to success in the profession of engineering. The differences in ratings by the two groups were tested by the Mann Whitney test. Nineteen out of the 45 traits showed significant difference. The nature of these traits and the implications of the findings are discussed.

29. Standardization of revised adjustment inventory (Rai).

PRAMOD KUMAR, Allahabad.

The revised Adjustment Inventory (RAI) is developed to screen the poorly adjusted college going students. It consists of 40 'Yes—No' type items taken from Asthana's, Woodworth's and Sanller's well known personality inventories.

It is a self-administering inventory and takes 20 to 25 minutes to answer it.

The sample consists of 229 randomly selected male engineering students with a mean age of 20·5 years. Mean, median, standard deviation, Skewness and Kurtosis are calculated.

Split-half reliability (correlating odd-even items) is found to be ·88 with an
lex of reliability of ·93. The test-retest reliability is also computed. It is found
be ·81 with an index of reliability of ·90 with one week's interval time.
The percentile norms are also provided for the purpose of interpretation.

). A study of the relationship between intelligence and some dispositional traits.

ADITI BHADURI, REBA BANERJEE and TAPATI ROY, Calcutta.

The present study aimed at determining the relationship, if any, between in-
lligence (abstract) and four dispositional traits characterised by Bernreuter Per-
nality Inventory (BPI), viz., B1 (Neuroticism), B2 (Self-sufficiency), B3 (Intro-
ersion) and B4 (Dominance).

The test battery consisting of : (1) Bengali version of BPI (shortened into 30
ems by the Indian Statistical Institute) and (2) a Group Intelligence test in
engali constructed by Dr. G. Pal and Sri S. Bose, was administered to a sample
50 girls reading in class XI of a Calcutta Multi-Purpose School, their age rang-
ig from 15 to 17.

The constituent eleven sub-tests of the said Group Intelligence test were
assified into two categories, verbal and numerical. Each of the four traits was
orrelated with the total intelligence score (I_{ts}) as well as with the other two
ores corresponding to the verbal (I_v) and numerical (I_n) categories, rendering
nally a correlation matrix of 12.

The matrix revealed three significant coefficients of correlation, each in case
f numerical, verbal and total scores of the Intelligence test used. While the
umerical portion of the Intelligence test was negatively correlated with Neuroti-
ism, the verbal part and the total test produced positive correlations with 'Domi-
ance' and 'Self-sufficiency' respectively. The range of correlation values was
ound to exist between +·01 and −·41.

The result corroborates the findings of earlier studies reported by Lorge,
Temzek, Stagner and others, that personality traits as measured by BPI are, in
eneral, poorly correlated with intelligence test-scores. However, some differential
sults are observed when the traits are individually considered against the total
id part-scores of the intelligence test employed here.

l. Validiation of the discriminative capcity of the Guilford Zimmerman temperament survey with reference to the temperamental profiles of student nurses, school teachers, and University boys and girls.

G. C. GUPTA, Delhi.

An adapted form of Guilford Zimmerman Temperament survey is administered
five samples of student nurses, University boys, University girls, school teachers
males and females). Significant differences between the means in the traits which
his survey assesses is found. An attempt is made to validate the test with res-
pect to only those traits on which such significant differences between such tem-
eramental profiles were observed. The study is still being continued.

2. Personality Pattern of Adolescent Children with Rorschach Test.

KRISHAN BIR, Delhi.

The aim of the present investigation was to determine the personality pattern
f adolescent Children with the Rorschach Test.

The Rorschach Test was administered to sixty (60) school children aged 13 years to 14 years 11 months. Scores for twenty-nine (29) Rorschach variables were intercorrelated and the matrix thus obtained was factorised by Burts·Method of Simple Summation.

Three factors were extracted :—

1. Factor of 'General Productivity' accounting for 29·88 per cent of total variance.
2. Factor of 'Instability' contributing 13·75 per cent of the total variance.
3. Factor of 'Instinctual Drives' sharing 9·61 per cent of the total variance.

33. Szondi patterns in Musicians : An examination of the Szondi signs of 'Musicality'.

MANAS RAYCHAUDHURI, Calcutta.

Susan Deri, a student and co-worker of Lipot Szondi, has proposed in her manual of Szondi Test that there are at least 7 Szondi Syndromes or preference-modes which significantly differentiate artists as well as musicians from normal people. The present study examined the discriminative power of those Szondi signs of 'musicality'.

Two groups of S's are used in this study (*i*) The experimental Group consisting of 30 successful professional musicians. The list of the musician group were compiled by three known expert and critic of music and (*ii*) The control Group consisting of 30 adults engaged in professions other than music or art.

A Chi Square test was made of those 7 signs of musicality in an effort to distinguish the musician from the control Group. The 7 signs as a group failed to significantly differentiate the groups; only one of those 7 individual signs i.e., 'minus hy' was significant in differentiating the groups. Considering that these 7 signs are regarded as the most important Szondi pattern of musical person, this study seriously doubts the usual mode of Szondi Test interpretation. It is suggested that further research should be geared toward remaking the present rationale and/ or developing a new set of stimulus pictures selected on a different theoretical frame.

CLINICAL PSYCHOLOGY

34. Schizophrenic language.

N. N. CHATTERJI, Calcutta.

The language of the schizophrenic patients often becomes incomprehensible as the construction of the sentence undergoes a peculiar disorganisation. Freud has shown that this disorganisation takes place when attempt at restitution is made of the withdrawn libido to the real objects but becomes unsuccessful. Author has tried to show that the disorganisation in the speech of the schizophrenics takes place due to regression as it takes up the magical character of infancy and also because it takes up the concrete from in contradistinction to the abstract form of the normal persons. Moreover, ego's control being weak working of the primary processes makes it further distorted.

35. A Problem Child—What guidance means to him.

SUDHIR PANCHBHAI, Calcutta.

The guidance work in most of the educational institutions in India is not satisfactory. Education is meant for the total development of a student's persolity and a School has an important role to play in this respect. Unfortunately d and non-psychological ways of correcting the student's behaviour have not en totally abandoned and hence the true goal of education is not yet fully alised.

In most of the institutions we find some problems regarding student's beha- our, and there are at least one or two per cent of problem children in each. Such ildren are generally so rigidly tackled that their behaviour becomes more com- lex in the later stages of development. In this paper, attempt has been made show how a psychological approach can help the child achieve his goal and how e general notions regarding him may be changed. A somewwhat new technique as been adopted to have a better teacher-pupil relationship in schools. The case istory cited is elaborate and indicative of various aspects of counselling pro- edure. Further, it has been noted that the behaviourial side of a student's develop- ent is directly and positively related to his academic achievements and by ckling the former aspect properly better results may be obtained in the latter.

6. An Experimental study of Alcohol and Drug addiction.

D. RAKSHIT and J. N. GUPTA, Calcutta.

From the accumulation of numerous scientific case studies of Alcohol and rug addicts under a long term project it has been found that every individual as complaints of one or more of the following illnesses.

(1) Nervous exhaustion, characterised by fatigue, insomnia, irritability.
(2) Anxiety group characterised by palpitation, excessive micturation, vertigo, shortness of breath, gastro-intestinal disturbances, trembling, agitolalia, etc.
(3) Vasovagal attacks, myosis.
(4) Hysteria group characterised by any number of pseudo-neurologic states of paralyses, paresis, contracture, etc.
(5) Depression, paraphasia, etc.
(6) Mysophobia and other forms of morbid fears.
(7) Impotency, enuresis, emission, delirium tremens, amnesia, dementia.

In determining the Psychological factors in prevention and treatment of lcohol and Drug addicts it is found out that there is no fundamental difference etween the psychology of the Alcoholic and the Drug addict.

Two forms of Psychological examinations are employed for diagnosis and reatment of the addicts. A cross section examination in which the complaints are ocussed upon and the present status determined; and a longitudinal examination n which the history of the patient and his illness are determined. The former nakes for diagnosis and the latter is more useful in treatment.

37. Metabolic Deficiency and Behaviour Pathology.

S. N. SINHA, Patna.

The present paper attempts to examine the effects of qualitative and quantitative nutritional deficiency (evidenced in lowered metabolic conditions), on varied forms of normal and pathological behaviour. From an appraisal of studies on quantitative dietary deficiency (as in food deprivation or semi-starvation) it becomes lear that the normal psychological processes of thinking, imagining, perceiving nd learning are significantly affected by it. The effects of quantitative deficiency has not yet been related to clinical manifestations of behaviour.

Qualitative nutritional failure or inadequacy can cause certain behaviour anomalies. Inadequate provision of vitamin B complex components in the diet, has been found to result in increased emotional reactivity in human S's. Nutritional failure due to lack of absorption of the dietary elements causes metabolic dysfunction, which results in pathological manifestations of behaviour. The effect of acute depletion of organic elements such as Magnesium has also been found to produce seizure states both in human and animal S's.

It is hoped that from an appraisal of the behavioural effects of nutritional failure or inadequacy, the genesis of psychopathological manifestations can better be understood in terms of a psycho-biochemical approach. However, the little done and the vast undone suggests the possibility of further fruitful explorations in the field of psycho-biochemical research.

38. Behaviour of the Subjects during Testing Sessions and its Effect on Subjects Performance.

MYRA SEN, Cooch Behar.

The present investigation aimed at finding out how far poor performance in conceptual tasks by Schizophrenic patients has been due to their deficiency in that ability and how far it could be accounted by other disorders like poor co-operativeness and lack of attention.

Two groups of subjects, one comprising of 35 Schizophrenics and the other 25 Normal, individually matched on variables like age, sex and education have been given the Haufmann-Kasanin test, as a test of conceptual ability and the Pass-along test as a test of intelligence. Subjects co-operativeness and attentivity have been carefully rated. Only 23% of the Schizophrenic subjects have shown marked disorders of co-operation while none of the Normal have manifested such behaviour. None of the Normal have shown any disorder of attention while about two-third of the Schizophrenic cases have shown various disorders.

The Haufmann-Kasanin test was administered in the modified way introduced by the present author and thus two different varieties of success, success with full credit and that with half credit standing for success within 25 minutes of performance and successful reproduction after demonstration of the solution, respectively have been assessed. Schizophrenic cases have shown much poorer performance in both the intelligence and conceptual tests, when compared to that of normal.

The general intelligence of the Normal subjects as assessed by the Pass-along test have been more closely associated with their achievements in the Haufmann-Kasanin test than that of the Schizophrenic subjects. Co-operativeness and attentivity of the subjects, in general, have been found to be closely associated with their achievements in the conceptual task as well as Pass-along test.

In the light of the present findings, it can be concluded that while interpreting test-performance one must take into consideration subjects co-operativeness, attention and like factors, specially in case of the Schizophrenics who are liable to have disorders in those fields due to their disease process, as disturbances in those fields can obstruct full utilization of subjects' ability. However, one should not stress its importance to the degree of dis-regarding the fact that Schizophrenics do suffer from deficiency in some abilities.

39. Learning under Hypnotically induced anxious and non-anxious conditions.

J. P. DAS, Cuttack.

Six somnambulist Ss were required to learn two lists of nonsense consonants varying in difficulty level. The learning was undertaken under high (HA) and low

(L.A) anxiety conditions. Anxiety was introduced by hypnotic suggestions during the somnambulic phase. It was hoped that by this method, transitory anxiety can be effectively induced and removed within a relatively short period, so that each subject becomes his own control while comparing the effect of anxiety and its absence on learning. The results show no difference between learning scores of H.A. and L.A. groups, although some characteristic difference could be apparent between the performance of the two groups, which corroborate comparative studies on incentives.

SOCIAL PSYCHOLOGY

40. Studies on some Aspects of Interaction in Leaderless Problem-solving situation : I. Participation.

PRABHAT K. MUKHOPADHYAY and JHARNA MUKHOPADHYAY, Calcutta.

On the basis of an assumption in group-dynamics that participation of the group members helps to an all-round betterment and economy of solving cognitive problems, the present experiment is designed by (i) varying the group-structure in sex-variant homogeneous group, (ii) nature of the problems and (iii) the experimental control as free-lance and restricted discussion as models of participation variance. Tape-Record Amplifier was used as the agency of experimental control. Post-discussion self-ratings and the number of correct answers respectively were taken as the subjective and objective criteria of measurements. Two groups of 40 school students were admitted into this experiment of which 10 sex-variant subgroups were the actual participants. One group was allowed to discuss freely over a problem where for the other it was restricted. It has been observed that free participation is a significant process to tap the potentials of the individuals for cognitive problem-solving without having a restriction either by group structure or by the nature of the problems. This process becomes optimally productive if the members are quite aware of their roles.

41. Stereotypes regarding Linguistic Groups.

B. KUPPUSWAMY and M. PARASIVAMURTHY, Mysore.

It is a familiar fact that after independence there was intense feeling among the people of the various states to reorganize the states so that all the people speaking one language form into one state and come under one administration. There was also the fear that unity of the country would be affected if regional languages become very predominant.

The present study was started in order to find out the stereotypes of the students in some colleges of Mysore city regarding themselves and regarding the people in other states.

The 50 attributes prepared by H. Narayanamurthy in 1953 were used. 150 Psychology students, 64 boys and 86 girls, studying in B.A. class were tested in 1959. The most frequent attributes with percentages were found for each of the 14 groups. Also the stereotype score was found by subtracting the average negative score from the average positive score.

It was found that the self picture of the group is very favorable and endorsed by a large majority. The highest positive scores were obtained by Mysore, Kashmir and Bengal while the highest negative scores were obtained by Madras, Maharashtra and Kerala.

42. Mediated Transfer of Attitudes.

J. P. DAS and P. C. NANDA, Cuttack.

Attitudes can not only be acquired, but may also be transferred like verbal CRs. This was shown by associating a nonsense syllable with the name of a tribe, then developing a favourable or unfavourable attitude towards the nonsense syllable and subsequently testing whether such an attitude has been transferred to the tribe. Two nonsense syllables and two names of tribes were chosen as stimuli in a counterbalanced Sensory Preconditioning (SPC) design requiring four groups of 20 *Ss*. A notable feature was the use of probability learning during the conditioning period; the probability of occurrance of 'good' or 'bad' after a nonsense syllable being. 85. Transfer, which was successful, was tested in two ways : (1) by requiring *Ss* to choose 10 out of a mixed list of 20 favourable and nonfavourable attributes for each tribe and (2) by rating each tribe on a semantic differential scale of good-bad. It was suggested that SPC may be essentially indistinguishable from classical conditioning.

43. Impact of Caste on Social distance among Gujaratis.

A. S. PATEL and U. C. SHROFF, Baroda.

The present investigation is an attempt first to construct a scale to measure social belongingness or distance, and then with it to study the nature of interrelationships between various castes in Gujarat from point of view of social distance. Accordingly, 'a measure of social belongingness' on a nine-point scale was constructed on line of modified or extended Bogardus scale and this was included in the questionnaire prepared to study the various aspects of social relations. The data were gathered on a sample of 230 Gujarati members of different upper and lower castes, spread over varied strata of socio-economic and educational levels. The main Gujarati castes with respect to whom the nature of social relations of above sampled Gujarati population was studied were eight castes, namely, Patidar, Bania, Brahmin, Harijan, Mochi, Kachhia, Hajam and Vaghri.

The analysis of all responses to the questionnaire warranted the following inferences in general :

(1) Usually, a person of one caste had most cordial and closer social relations with persons of the same caste and comparatively less intimate relations with members of other castes.

(2) As viewed by Gujarati sample on the whole, the order of castes from nearest to most distant stood thus : Patidar, Bania, Brahmin, Harijan, Mochi, Kachhia, Hajam and Vaghri.

(3) For most sub-groups, Patidar stood the nearest and enjoyed the confidence of most, while Vaghri was the farthest for admost all.

(4) There was a tendency with lower caste members to view with the eyes of upper caste members.

(5) The lesser the distance, the higher were the liking scores an the proneness scores.

(6) Opinions about lower castes were based on lesser experience or contacts.

44. A study of Social Distance in a Group.

BIMALESWAR DE, Muzaffarpur, and JAIBALLAV SINGH, Ranchi.

The present paper is based upon the findings of a study undertaken by the authors on the Topography of a Group. In this study the structure of a group consisting of twelve male students of the final year Psychology Honours Class of Ranchi College was analysed by Moreno's sociometric technique. With this technique an attempt was made to evaluate quantitatively the influence of such a variable as group belongingness on the 'friendship choices' of the members.

The quantitative study of the topography of the group was made on the basis of a preference scale, the two limits of which were : +100% and—100%. The psychological limits of these two values are : most dislike or least preferred, and most liked or most preferred.

The members were asked to locate their preferred friends and also non-preferred ones on this scale. From the data obtained by administering the above scale, the values of social distance from each member to the group and that from the group to each member were calculated by the formula : if the preference expressed by one member for another is 100%, then social distance between them is equal to 0. The social distance, therefore, between any two members has been obtained by calculating the difference between the preference value and 100, which is the maximum on the scale. For example, if A's preference value for B is 50, then B's social distance from A is : 100—50=50. Similarly, the maximum value for non-preference on the scale is—100%, which means total rejection. Here then value of social distance will be : 100—(−100)=200, the maximum value of social distance possible according to the scale.

On the basis of the values of social distance obtained, such factors as 'attractiveness', 'forces of attraction and rejection' were operationally analysed and members were located in a group space in terms of their attractiveness, their location, i.e., whether in the inner circle or in the periphery of the group space, relative centrality, and forces of attraction and rejection operating in the group space. In addition to all this, such phenomena as leadership, sociometric status and academic adjustment were also enquired into.

45. Nature of Stereotypes : A Suggestion.

R. K. MISRA, Lucknow.

A stereotype is defined as a hypothetical construct which refers to the process of establishing and maintaining a state of psycho-social homeostasis. We come across different situations at every movement in our everyday life. There is thus a constant demand to maintain a psycho-biological and a psycho-social balance with our environment. Stereotypes help us in this effort. It is proposed that the nature and process of stereotyping could be understood well if stereotypes are viewed as varying along a few dimensions which may also be taken as "stereotype-characteristics". These may be mentioned as openness, activation, selection, learning, mechanization, cumulation and symbolization. Stereotypes are a pliable control system, amneable to subsequent modification, maintaining constant communication with the environment, are highly selective in incorporating their content, gradually acquire a ritualistic character, are not hostile to their "family members", and possess a symbolic value furnishing an individual with units to represent his experiences.

46. The Spatial Factor and Pair Formation in Small Discussion groups.

AMITAVA CHATTERJEE, Kharagpur.

The dynamics of small discussion groups depend mainly upon the interaction-transmission. But the interactions between members are in some way dependent upon the spatial factor. In other words, the seating arrangement in small discussion groups help to determine the individuals between whom the interaction process will flow. This verbal altercations between members give rise to the formation of paid groupings, which again is facilitated by the seating arrangement.

The present paper is a further extension of the study on small discussion groups. Here the observations of a small group, consisting of eight members are reported. The members were the participants in a short-term residential study course. The group were meeting in several sessions to discuss different case study problems. The data for the five sessions are analysed here. The seating positions of the members are quantified in order from the left of the leader's Chair. The order of interaction of each individual member is noted and from that order the pair groupings are identified following the particular analytical design developed by Josephine Klein. It is observed that the seating positions of the members remain consistent to the span of time. It is also noted that there is a definite relationship between the pair groupings and the spatial factor in small discussion groups.

47. Difference of opinion in the educated public about some Socio-political issues.

AMAL KUMAR MALLICK, Calcutta.

Opinion of educated people on some socio-political issues has been surveyed. They have been found to possess definite opinion, favourable or unfavourable, about all the issues except one and their response pattern is statistically significant beyond ·01 level.

The sample is broken down into different sub-groups on the basis of sex and economic status. The difference in opinion between the sub-groups is found to be significant (a) when the general opinion has not at all crystallised and (b) when it has somewhat crystallised with no significant trend. But the difference in intra-group opinion is not significant in the case of those issues about which inter-group opinion (i) has either highly or considerably crystallised and (ii) has a definite trend even if it has not appreciably crystallised. Further investigations in this direction is being carried on by the author under a Research Scholarship Scheme of the Government of India.

48. Extraversion, Neuroticism and Conformity Behaviour.

S. D. SINGH and K. C. GUPTĀ, Chandigarh.

The present experiment was mainly designed to study the relationship between conformity and extroversion, and neuroticism dimensions personality respectively. A group of 64 post-graduate students, 32 males and 32 females served as Ss. They were selected and also classified into four personality groups : high neuroticism and high extroversion group, high neuroticism and low extroversion group, low neuroticism and high extroversion groups, and low extraversion and low neuroticism group. The stimulus material consisted of 10 slides, each having unequal number of white and black dots. Each slide was exposed twice to each S for a period of 1 sec. in a dark room, and after each exposure the S. was required to tell which of the two kinds of dots were larger in number. Each S had two experimental sessions : Individual session, when all the slides were exposed to the Ss. individually, and group session, when the slides were presented to the Ss along with two confederates, and each S occupied position II or III for either of the two exposures of each slides. The results of the experiment showed that the Ss conformed significantly more at position III than at position II. The low neuroticism Ss conformed somewhat significantly more than the high neuroticism Ss, while extroverts conformed more than the introverts, but the differences were not significant. Similarly, though females showed greater conformity than males, the difference between the two sex groups was insignificant.

49. A Psychological Analysis of Tensions.

S. V. KALE, Bombay.

It is necessary to search for common basic factors in tensions of group life at various levels—social or economic, national or international. Concentration of research at present is on two situations : (1) tension to which single individuals are liable; (2) tensions in small groups. Psychologically, the process of tension occupies a middle position on the continuum of desirability-undesirability, of scientific concepts. Tension acts as a built-in release mechanism which helps to reduce the intensity of a drive or to achieve a goal in behaviour. The continuation of the state of tension much depends on the clarity and definiteness of the goal. In the absence of definite goal, tension takes the form of anxiety, frustration, conflict or emphasis on obstacles or achievement. Especially, in conflict-situtions, the influence of social factors in individual tensions is apparent, as it is primarily the social factors that determine which actions are rewarded and which are not.

In group-tensions, the main factors that aggravate them are competition and rivalry. From well-known studies on the relation of groups to induced and forced changes such as by Coch and French, we can draw certain conclusions which can be applied to the problem of securing co-operation of people in India to planned economic change.

50. A Study of Quality and Quantity of Work, Pattern of Interpersonal Relations and Leader Popularity under Democratic, Authoritarian and Consultatives Styles of Leadership.

V. V. PENDSE, Poona.

The psychological descriptions of the democratic and authoritarian styles of leadership are given by Lippitt and White. The consultative style of leadership differs from these two principal styles in respect of making decisions, executing plans, forming interpersonal relations etc. The consultative leader-personality is expected to be more relaxed, integrating and a better builder of human relations.

To investigate the quality and quantity of work done, the pattern of interpersonal relations formed, etc. under the three leadership climates, three roughly equated groups of children were made to experience and work under one leadership climate each. One adult leader, who enacted the three leadership roles, led these groups, one after the other. He appeared to the children as a craft-teacher and tought them preparing paper-models.

Two observers took down detailed notes of the experimental sessions and rated each aspect of the leader to child, child to child and also child to leader behaviour. Three independent judges judged the quality and the quantity of work done by each group. The members of each group answered a short questionnaire and thus indicated their reactions to the leader-behaviour.

One of the important results of the study was :—

(i) the consultative leader was the most popular and was admired and respected;

(ii) the authoritorian leader was respected but feared, and was unpopular with the group-members;

(iii) the democratic leader was neither admired, nor respected, nor feared by the members of his group, and he was also not popular with them.

VOCATIONAL & INDUSTRIAL PSYCHOLOGY

51. Union Attitude and Job Satisfaction.

DURGANAND SINHA and K. C. SARMA, Allahabad.

The relationship between attitude towards union and job satisfaction was studied on a sample of 100 workers in a light engineering factory by the use of specially constructed interview schedules. There was a significant negative association between the two ($r = -0{\cdot}47$). Thus, workers with more favourable attitude towards the union were on the whole dissatisfied with the job.

Of the personal factors, marital status and length of union membership were significantly related to job satisfaction. Age, education and income did not show any significant relationship.

None of the personal factors were found to influence union-attitude significantly. Using multiple regression analysis, information on marital status, number of dependants, total income and length of union-membership combined were significant to enable prediction of job satisfaction score.

The results are discussed.

52. Interest Pattern of School Teachers.

R. G. CHATTERJEA and G. B. SAHA, Calcutta.

The present study is an attempt to show the degree of difference in the interest pattern of school teachers of either sex in different dimensions of interest in the same line of strongs' VIB.

The form of quqestionnaire consisted of 48 occupations, 41 amusements, 41 curricular subjects, 19 activities and 23 personality types. The survey was conducted on a three point scale viz., Like, Indifferent, Dislike. Total number of subjects was 66—44 male and 22 female. The result of five dimensions of interest was calculated in percentage basis.

The interest pattern of the teachers are markedly alike in certain dimensions though divergences are none the less great. In matter of liking teaching in college is favoured by all, discrepancies appear in jobs like business, mechanics etc. While the curricular subjects as literature, psychology, history and amusements like travelling, picnics etc. are most favoured by the teachers.

Close resemblance seems to be present in the pattern of interest in the field of activities and personality types.

53. A study on some specific causes of Industrial Absenteeism and its effect.

SAMIR KUMAR DEY, Calcutta.

The success of an industry depends on the reduction of Absenteeism. The worker is always confrotned with two diverse motives—the desire to do work and the desire to avoid it. The triumph of the later motive often leads to Absenteeism.

The present study was conducted in a Jute Mill and relates to the second motive and the factors that affect it. The study was based on the absenteeism rate prevailing in the Jute Mill and the causes given to it. The causes were further analysed to get into a meaningful whole, and the points which the study included were—

(i) the study of production in the department where absenteeism rate was higher;
(ii) industrial relationship that existed in that shop.

The main causes of industrial absenteeism from the study was concluded to be due to the following heads :—

(i)	Physical condition of working place	9%
(ii)	Facilities provided by the Company	6%
(iii)	Frequency of family illness and social causes	19%
(iv)	Consciousness of responsibility	2%
(v)	Understanding of Company's policy	4%
(vi)	Frequency of employees' illness	27%
(vii)	Vices of the workers	6%
(viii)	Worker-supervisor relationship	18%
(ix)	Earnings and absenteeism	6%
(x)	Psychological factors	3%

From the study it is concluded that after the working of Employees' State Insurance Scheme, authorised leave has increased in relation to unauthorised.

Further, it is found that where higher is the rate of absenteeism lower is the efficiency there (in the department), with corresponding repercussion on the labour relation and labour condition in the organisation, resulting in the increase of labour turn over, disputes and frustrations etc.

Absenteeism is the end result of three fold causes i.e. those relating to the conditions in an industry, those to the conditions outside it and the rest relating to mental life of the worker.

54. Job Satisfaction and Absententeeism.

DURGANAND SINHA and PARMAJIT SINGH, Allahabad.

Absence of personnel from work has a very disorganizing effect on work-efficiency. The present investigation has been designed to investigate the relationship of job satisfaction with work-attendance. It also throws light on the operation of certain personal factors.

In the works of a large steel plant, 72 workers with high absentee rate (20 per cent or more) and 156 with low rate (3 per cent or less) mere isolated. Out of these, 50 workers from each of the groups were randomly selected for study. A job satisfaction schedule was applied and each worker was also rated by the foremen as to his attendance, enthusiasm for work, satisfaction, loyalty to company and overall assessment.

Using the Spearman Brown formula, the job satisfaction schedule yielded a reliability coefficient of ·84. Comparing the job satisfaction scores of the high and low absentee groups, the difference was found to be significant ($t=4{\cdot}53$; $df=98$). Workers who were more frequently absent were much less satisfied with their work than the regular works.

Scrutinizing the different areas of job satisfaction, it as observed that workers with high incidence of absence tended to be relatively less satisfied than regular workers with regard to nature of work, supervisors and supervision, company policy and wage and security. The difference was, however, significant only with regard to be last one. Comparing the ratings, it was observed that regular workers were significantly rated "better" and those with high incidence of absence as "poor" by the foremen ($t=5{\cdot}046$; $df=98$). Of the personal factors, only income level was found to have significant relationship to attendance, high-income group being the most regular and middle income the least regular.

The importance of job satisfaction as a factor behind absenteeism is stressed. It can be said that a low absentee worker is on the whole satisfied, belongs to the higher income group, and is looked upon as generally satisfactory by his foreman. The high absentee worker is less satisfied, belongs to the middle income group, is a little younger, has changed his job, and is also viewed by his supervision as less satisfactory as a worker.

55. A study of Incentives and Motivation in a Group of Supervisors.

L. J. BHATT and N. S. PATHAK, Baroda.

The paper reports a study of attitudes of a group of supervisors towards various incentives. The questionnaire method, as in the study by Blum and J. Ress, was used in the first case; and in the second case, a study of the factors influencing job satisfaction was made. The supervisors who participated in this study were those undergoing training and were thus readily available for participating in the study. Their responses are tabulated and conclusions drawn for the group.

56. A study of Factors contributing towards Absenteeism among the workers in Industry.

V. S. PANDIT, Baroda.

Absenteeism, defined as the cessation of work for not less than one whole working day, is surveyed in this paper. The investigation was carried out in the Gujarat Rubber Factory and Laxmi Vijay Iron and Brass Works of Baroda. Interview and questionnaire techniques were used. The data obtained were subjected to Chi-Square test. Various relationships like (1) educational level as the cause, (2) age, (3) job dissatisfaction, (4) environmental conditions, (5) marital status etc. are studied and conclusions drawn.

57. A study of Factors that influence Co-operation in a Factory.

L. J. BHATT, Baroda.

Characteristics essential to co-operation include: (1) a common purpose, (2) recognition of mutuality of interests, (3) working together to achieve that common purpose, (4) sub-mergence of individual interests, etc.

A group of supervisors who were undergoing a certificate Course in Supervision and Foremanship were asked to respond to a check-list. The check-list was adapted from material developed for the General Motors Executive Training Programme and it includes items covering (a) conditions of work, (b) organisational information, (c) Job skills, (d) worker's attitude, (e) supervisor's attitude. Preliminary conclusions are drawn from the responses of this group. The second part is being prepared to analyse attitudes with a further investigation.

58. Interest Pattern of the persons engaged in Engineering and Medical Profession.

R. G. CHATTERJEA and JALADHAR MULLICK, Calcutta.

The paper purports to report the result of an investigation relating to the interest pattern of engineers and physicians in five dimensions. The engineer sample consisted of 80 individuals engaged in engineering profession and all were well educated with adequate experience in the line. The physicians' group comprised of 110 persons, most of them having foreign diplomas and had a wide range of experience in their profession.

Certain curricular subjects were highly preferred by the engineers and the doctors. Those were closely associated with their profession. 'Literature' is the only curricular subject that is liked by both. Similarities in likes and dislikes of both the professional groups are found in their interest in personality types. Certain disparities, however, in their judgments so far as activities are concerned are found.

59. Qualities Desirable for Engineering students and Profession (Comparison of the Teachers' and the students' samples).

DURGANAND SINHA (Allahabad) and HEMKANT MISRA (Kharagpur).

The ratings given by 40 teachers and 30 students of an engineering institution to 45 predefined personality traits in an eight point scale were compared. The ratings of the traits for relevance to success in engineering education as well as profession showed marked similarity among the teachers and students of the same institution. The nature of the few traits in which the two groups differed and the implications of the findings are discussed.

EDUCATIONAL PSYCHOLOGY

60. An analysis of the Unstructured Composition written by children from upper-middle and low Socio-economic Status Level.

PREM PASRICHA, Baroda.

This study has been preceded by an exactly parallel one on structured composition. The purpose of this study was two-fold :

(1) To compare the extent and nature of vocabulary used by children of upper-middle and low socio-economic status.
(2) To compare the extent and nature of vocabulary used in structured and unstructured compositions.

The sample consisted of sixth class children of two schools located in the same locality but catering to children coming from different levels of Socio-economic status.

Both were boys' schools, one catering to children coming from upper-middle class families and the other to those coming from low S.E.S. level.

Completely free compositions of these children were collected. No time limit was imposed on their writing but space limit was there.

These compositions were analysed for the extent of vocabulary—repeated words and new words—as well as for the types of words used therein. Means for all categories were calculated and comparisons were made between the two levels of S.E.S. and the two types of compositions i.e. structured and unstructured.

The frequency of words used had the same order in unstructured compositions as was recorded in structured compositions with only one displacement.

The structured composition revealed a wide extent of vocabulary than the unstructured composition.

Children from upper-middle S.E.S. level revealed a larger vocabulary than that revealed by children from low S.E.S. level.

61. Typography and Legibility of Hindi Print—A Factorial Experiment.

B. S. BHAGOLIWAL, Calcutta.

Legibility of print has been thoroughly studied in English; and specifications have been experimentally set up for different typographical factors. But most of these studies took up only one variable at a time or, at the most, two, while it has been established that interactions do play a significant role. Also there have been no experimental studies to develop specifications for Hindi. The present study is an attempt to show the influence of three main typographcal dimensions and their inter-actions on the legibility of Hindi print. For this purpose a factorial design was developed to study the role of three main factors viz. type size, line-width and leading or interliner spacing. The whole experiment was performed under strictly controlled conditions on 18 students of class VIII standard, having Hindi as their mother tongue and matched for age and their achievement in Hindi. The method for measuring readability was speed of reading aloud at a normal reading distance. The data when analysed with the analysis of variance technique reveal significant variations for the two-factor and three-factor interactions.

62. A study on Curricular Guidance.

A. K. ROY, Agartala.

The aim of this investigation was to offer curricular guidance to students at VIII standard in class XI schools with diversified courses in the Union Territory of Tripura.

The students of VIII class in 5 different institutions were the subjects of this guidance project. The number of subjects included was 678.

At first a series of orientation talks was arranged for the benefit of pupils in different institutions. In these talks Psychologist explained in general terms the purpose of the guidance scheme, the problem of educational choice at the end of VIII standard, the relation between the educational choices and their future vocational plans etc.

The pupil data were obtained from various sources—from the pupils themselves, parents or guardians, teachers, school achievement records. In addition to the above a battery of Psychological tests was constructed and administered to school subjects and result of the test battery was taken into consideration in allocating the children to one or the other of the diversified courses of curriculum. All possible attempts were made to match as far as practicable the abilities possessed by the pupils with demands of the different streams of study.

Final recommendation as to the allocation of the student to one of the six courses (technical, commerce, humanities, home science and fine arts available in the 5 schools) was arrived at not only after considering the single criterion i.e. result of the test-battery but several other factors such as socio-economic background of the pupil, his neighbourhood influences, teachers' estimates of pupil's abilities, pupil's expressed interests and hobbies in line with the elective course were also taken into account.

Analysis of results revealed that of the 678 students, about 6% of the cases were considered suitable and allocated to technical stream, 12% to commerce group, 31% to science curriculam, 44% to humanities, 7% to home science course and ·9% to fine arts group. It was further observed that 4% of the students failed to realise the relation between curricular choices and occupational goals.

The soundness of this allocation procedure, however, is to be further tested by following up studies.

63. Prediction of College success in Technical subjects on the basis of an Intelligence Test.

R. K. TANDON, Moradabad.

An enormous number of failures are observed every year specially in technical subjects of the Indian colleges. If the 'intelligence' of our students is properly measured and if right type of guidance is provided to them, much of the educational maladjustment may be avoided. Thus, the present study deals with a problem as to how far a test of general mental ability can predict college success in the technical subjects like Mining and Metallurgy, Agriculture and Engineering of an Indian University.

For this study, we have taken a test of intelligence, namely the Group Test of General Mental Ability, 20/52 Form, prepared by Dr. Jalota and the author, Laboratory of Experimental Psychology, Banaras Hindu University. They have been administered to 103, 107 and 217 B.H.U. students of Mining and Metallurgy (I, II and III year sections), Agriculture (I, II & III year sections), and Engineering (I and II year sections) Faculties respectively. The total scores and the nine subtests of the present test have been correlated with the University Examination Marks.

Our study reveals that the prediction of success in the technical subjects of Mining and Metallurgy, Agriculture and Engineering groups considered is difficult on the basis of the test used by us. However, it seems that a reliable predictive instrument would require a combination of certain measures of which an intelligence test like 20/52 Form may be one. Other significant result which appears is that different subjects correlate high in different groups. Thus, it may be concluded that different abilities contribute in varying proportions towards the college success in different groups. Consequently, different combinational measures may be required for each group considered by us. Lastly, we have found that the correlation co-efficient generally recede as we proceed from 1st year onwards in the three groups considered. Thus, the mental abilities measured by an intelligence test are more in evidence in the academic subjects of the 1st years than any of the subsequent years. Hence, a test of intelligence may carry more weight in any combinational measure for prognostic purposes during the beginning of the technical courses.

64. Science Practical Examinations—A suggestion for abolition.

S. C. CHAKRAVARTY, Mhow.

Science studies in this country are suffering from various drawbacks like want of equipment, laboratory facilities, qualified teachers, suitable text books etc. In addition to these there is a new evil that has crept up which may be termed as 'humane factor' in the conduction of practical examinations, the object of the present paper is to invite the attention of our educationists to it. To find out whether in the present educational system an equal attention is being paid to both the practical and theoretical aspects, it is necessary to determine the correlation existing between the percentage of marks secured by individual students in them in a subject. As this is not easy due to a large number of reasons, solution of the problem has been attempted from the number of students declared eligible for supplementary examination, in certain universities, in either theory or practical indicating the subject and the paper in which only they have failed.

Out of approximately 7,600 students sitting in the different B.Sc. examinations of 1960 and 1961 of the Vikram and Agra Universities 850 qualified for supplementary in theory and 37 in practicals, the latter forming only 4·35% of the total. This clearly demonstrates that passing in the practicals is hardly a problem for our students. It may be pointed out that it is not only so in these two Universities but in a major part of the country both at the University and Higher Secondary levels. The author, on analysing the factors responsible, suggests that the practical examination should be replaced with a system of grading under a suitable scheme, the final division in the University examinations being declared on the basis of marks obtained in the theory papers only. This will prevent the boosted up results of students through lenient markings in practicals from coming in the way of their selection on the basis of real merit for admission in technical colleges in States where no competitive examination is held for the purpose and also in the selection of personnel for research, teaching and industrial organisations through direct recruitment. It is needless to mention that successful industrialisation of the country envisaged in the current and successive Five-Year Plans would depend upon the availability of the right type of scientists and technologists at the right time.

65. Attitude of Guardians towards Sex-education.

PRAKASH CHITTA NANDY, Calcutta.

It has been observed that most serious mal-adjustments and personality difficulties have their roots in early childhood and specially sex plays the prominent role among all the reasons giving a shape to it. Presently Psychologists and educationists are thinking to root out the ill effects of sex. The present author has already taken this problem and has probably been able to find out the opinions of the guardians towards the utility of the sex-education.

The method used was a questionnaire, specially adopted for the purpose. The subjects were the guardians. The items of the questionnaire were selected very carefully by a pilot survey, and with proper weightage on the five point scale. The method in social research—by Goode and Hatt was followed for the scoring purpose as it has a very high correlation with that of Likert's.

The nature of the graph plotted from the entire data obtained from the guardians shows that it has a definite inclination towards the maximum scores which again indicates that the guardians have the opinions in support of imparting Sex-knowledge. Also the high correlation indicates that their decisions were actually reliable and valid and were in favour.

66. Media of Instruction in Schools and Mental Tests.

P. S. VIVEKANATHAN and SHAKEELA BEGAM, Bangalore.

In this paper the authors try to evaluate the effect of media of instruction in schools over mental tests. These mental tests are parts of the selection tests in an industry. The sample of 41 girls was randomly collected from the population of 88 girl candidates for the job of Radio Tube Mounting. The data was analysed on the basis of different media of instruction in schools of the girls. The total sample was divided into two groups : (1) English Group, those who studied under

English Medium and (2) Non-English group, those who studied under any medium other than English. From the analysis of C.R. between English group and Non-English group, the following conclusions are drawn :

(1) English group is better in Mental Tests than Non-English group.

(2) As far as dexterity tests are concerned English group is equal to Non-English group.

(3) On the whole, the English group is superior to the Non-English group. Admittedly the sample for this study is very small and so from this study any generalisation is impossible. But it is hoped that the present study may pave the way for further and intense study in this line.

SECTION OF ENGINEERING AND METALLURGY

President : DR. V. CADAMBE

Abstracts

(1) ELECTRICAL & ELECTRONICS

1. The irregularities in the F_2 region of the ionosphere and the fading of radio signals.

S. S. BANERJEE, S. C. CHAKRAVARTY and P. K. MUKHERJEE,
Varanasi.

The irregularities in the F_2 region of the ionosphere were studied with the observations of fading of a single radio wave reflected from the ionosphere at vertial incidence employing the well-known spaced receiver technique, with high frequency pulses locally generated at the frequency of 7·0 to 7·3 Mc/sec. Such observations were also possible sometimes at oblique incidence with c.w. transmissions from A.I.R. Delhi on 15 Mc. band.

The irregularities studied in the present investigations included the measurements of drift velocity, line-of-sight r.m.s. velocity and the estimations of the size of the irregularities and the angular spread of the radio waves scattered by them. The uniform movement of the irregularities was studied by determining the drift velocities from the time-shifts of similar fading patterns. In some cases when the time-shifts between the fading patterns could not be visually estimated, the drift velocity was determined from their cross and auto-correlagrams. From the several records taken during the period from Nov. 1960 to March 1961, the drift velocities of the irregulalrities in the F_2 region were found to lie between the range of 15 to 70 metres/sec. and the more frequent values were found to lie between 20 to 30 metres/sec.

If the movement of the irregularities is not uniform, the fading patterns obtained from spaced aerials are necessarily of random and dissimilar nature. In such cases the line-of-sight r.m.s. velocity of the irregularities was determined and was found to lie between zero and 4 metres/sec. The values obtained for the characteristic length of the irregularities and the spread of the angle of radio waves scattered from them are presented in the form of histograms. The average values of the characteristic length and the angular spread, however, are found to be 130 metres and 7 degrees respectively. It may be mentioned that the angular spread was also determined from the variation in the angle of arrival of the downcoming radio waves from the ionosphere and the results obtained by the two methods were in fairly good agreement.

2. Three-phase Transistorised Oscillator.

S. S. BANERJEE, A. B. BHATTACHARYA and S. K. CHATTOPADHYAYA,
Varanasi.

Three-phase oscillators generally suffer from the defect of generating more than one mode of oscillations as shown in one of our previous papers (Proc. Ind. Sci. Cong. Part III, 1960, p. 636). In the present communication the design of a symmetrical three-phase transistorised oscillator has been discussed which is capable of generating single frequency oscillations. The possibility of generating more than one mode of oscillations has been eliminated by the proper choice of coupling network between the transistor amplifier stages. It has been realised that the condition for the maintenance of oscillations and the expression for the frequency of oscillations can be easily obtained by matrix summation method. It has been shown that the three-phase oscillator presents a typical case where the matrix method of analysis in cascade type of oscillators can be employed with great advantage. The frequency term for the symmetrical three-phase oscillator has been found to depend on the collector load resistance and the effective capacitance between the collector and the ground terminals of each transistor in the oscillator. It was further found that the above effective capacitance limits the highest frequency that can be obtained with the help of such an oscillator. It has been incidentally observed that the maximum frequency generated by the oscillator can be conveniently used to determine the collector transition capacitance accurately under different operating conditions of the transistor.

3. Design of Transistorised Wattmeters.

S. S. BANERJEE, M. SENGUPTA and A. P. KULSHRESHTHA, Varanasi.

The property of non-linear operation of triodes and pentodes has been utilised by several investigators for the design of electronic wattmeters. Several improvements, however, have been found to be necessary in the design of such instruments as shown in some of our previous publications (Proc. 44th Ind. Sci. Cong., 1957, Part III, Abs., p. 469 and Jour. Sci. & Industr. Res. Vol. 20A 1961, p. 265). In view of developing portable type of such instrument the above principle has been extended to the design and construction of transistorised wattmeter which is found to be much superior to the conventional type of the electronic instrument particularly with respect to its accuracy, sensitivity, and simplicity of operation. In this instrument two transistors are used push-pull and operated non-linearly in the grounded emitter configuration. It may be mentioned that the grounded emitter configuration is preferred as it was found that several transistors in this configuration have a fairly wide squaring region in their transfer characteristics. The emitter ends are connected together to a high resistance which is connected to one end of the load, the other end of which is connected to a low resistance to provide a component of the load current for the input to the transistors. The range of the instrument can be changed by varying the high resistance in the input circuit of the two transistors. A d.c. microammeter as used in the conventional instrument is connected differentially across the collector circuit to record the power consumed by the load. The principle of operation of the above transistorised wattmeter has been explained by circuit analysis and the expressions for its sensitivity has been derived. The performance of the instrument has been compared with a standard electrodynamic wattmeter at power frequency and is found to be fairly satisfactory.

4. A comparative study of the performance of a Harmonic Generator with respect to Fractional sine wave. Isosceles Triangle wave and Rectangular wave, pulse drives.

K. S. PATEL and B. M. BANERJEE, Calcutta.

The full sine wave drive through a Class-C Harmonic Generator is limited at the most to the 4th or 5th order harmonics. The reason for this appears to be the inverse mode of decrease of the angle of plate current flow (α/τ) with the order of harmonic and that driving power increased very rapidly as (α/τ) becomes smaller.

The rectangular pulse drive, through a wide band circuit as proposed by the authors, however, does not suffer from these disadvantages and makes practical generation of the harmonics higher than the 5th. The performance of the generator is calculated out in terms of $(Cn)_{opt.}$, $(\alpha/\tau)_{n\ critical}$ and $(Aav)_n$ i.e. the values of the harmonic amplitude, angle of plate current flow, and the d-c value of plate current pulse, in the optimum case. The plot of $(Cn)_{opt.}$ vs. $(\alpha/\tau)_{n\ critical}$ for harmonics upto the 15th, shows a linear relationship, this is explained from the inverse mode of their decrease with the harmonic number.

The calculation extended to the case of Fractional sine wave and Isosceles Triangle, pulse drives shows similar relation between the parameters; besides, the ratio $\left[\frac{(C_n)_{opt.}}{(A_{av})_n}\right]$ remains sensibly constant and independent of the harmonics for the three types of pulse drives. The relative merits of each drive is brought out and explained. Full sine wave drive voltage for different (α/τ) ratio for the tube type QQE/06/40 is given for comparison.

5. Effect of Grid-Bias on the Noise Output of a Gas-Triode.

K. K. BOSE, Kharagpur.

One of the most common source of electrical noise is a gas discharge tube. In all electronic noise-generators either a gas-diode or a thyratron is used as noise source. In cases where thyratron is used the grid is generally connected to the anode of the tube so that the tube actually acts as a diode. It has been observed, however, that the control-grid of the thyratron which has normally no influence on the discharge current, can very effectively control the noise output of the tube. No reference of this phenomenon has been found anywhere by the author, but it confirms the suggestion made by Labrun and Bigg (Proc. Phys. Soc. Vol. 165, 1952) that the noise from a discharge tube is not of thermal origin. In the paper the experimental observations of the influence of the negative grid voltage on the overall noise output of the thyratron have been presented. The practical utilisation and application of this have been discussed.

6. Some effects of Bandwidth Limitation on P.S.M., P.L.M. and P.P.M. Signals.

J. DAS, Kharagpur.

A comparative study of the effects of bandwidth reduction on such important parameters as (i) sideband and harmonic distortions, (ii) crosstalk attenuation and (iii) signal-to-noise ratios, in case of p.s.m., p.l.m., and p.p.m. systems has been made. It is shown that the harmonic distortion in p.s.m. and p.l.m. are similar, whereas p.p.m. has no harmonic distortion. But the sideband distortion for large modulation indices is considerable in p.p.m. and p.l.m. only. The crosstalk attenuation is generally maximum in p.p.m. and for very narrow bandwidths p.s.m. shows improvement over p.l.m. The signal-to-noise ratios are also better in p.p.m. for average bandwidths but the p.s.m.—ratios improve when the bandwidth is very much restricted. Due to the absence of sideband distortion in p.s.m., the overall message grade in this system is found to be better than those in p.p.m. and p.l.m. for narrow-band working. For large bandwidths, however, p.p.m. gives the best grade of service.

7. Study of the Behaviour Pattern of Nylon Sheathed Outdoor Cables for use in Tropical Climates

COLONEL B. M. CHAKRAVARTI, Bangalore.

The operating conditions encountered by field type of telephone cables which remain exposed to outdoors are rather severe in India. Cables for such applications should show stable electrical characteristics and a reasonably long life under severe tropical climatic conditions. These aspects could be realistially examined by exposing the cable specimens at the required operational areas for long periods. But, often, such long exposures are neither practicable nor acceptable. Designers prefer to find out the same information quickly by what are commonly known as the "accelerated" tests. However, at present, there are no universally accepted methods for estimating the actual outdoor behaviour and life of these cables by a laboratory process.

In this paper, the author has reported on his investigations on specimens of polyethylene insulated, nylon sheathed, field cables exposed to typical outdoor climates in India. The stability of the characteristics of the specimen under a laboratory simulated climatic sequence has been studied. An attempt has been made to establish a suitable laboratory test for determining their relative outdoor life.

For obtaining the actual outdoor life, the specimens were exposed at a field station near JODHPUR. The results obtained so far have been reported.

(2) DESIGN & PRODUCTION

8. Quality Control in Fan Industry.

S. CHAUDHURI, Calcutta.

The author gives a statistical quality control scheme as may be utilised in fan industry for better quality production at less cost operation. From the view-point of statistical quality control he gives the function of the different departments in this industry viz., (a) progress dept. (b) assembly dept. (c) manufacturing dept. (d) inspection dept. (e) development dept. (f) maintenance dept. and (g) quality control dept.

Quality control is an effective system for co-ordinating the quality maintenance and quality improvement efforts for the various groups in an organization so as to enable production at the most economical level which allow for full customers' satisfaction. Varying with the circumstances of each application from an over all quality control programme the following benefits may be expected.

(i) Improvement in product quality.
(ii) Improvement in product design.
(iii) Improvement in employee morale.
(iv) Improvement in amount of production.
(v) Reduction in operating cost.
(vi) Reduction in operating loss.
(vii) Reduction in production line bottle-neck.
(viii) Reduction in spoilage and rework.
(ix) Reduction in unnecessary Machine adjustments.
(x) Over-all saving in price and money.

The author discusses all these benefits in respect of fan industry.

9. Optimisation of Squared off Cascade as applied to the process of Distillation.

D. GUPTA* and S. N. RAY*, Bombay.

Some generalised relations have been developed with all the necessary cost factors for the design of a distillation plant for the separation of stable isotopes based on the principles of Squared off Cascade. These relations are useful for the design of a plant for the enrichment of an isotope in the concentration ranges upto about 5 per cent. They have been used to design a water distillation plant for the enrichment of heavy water.

(3) METALLURGY

10. Underground Corrosion of Metals and Alloys under Indian conditions.

K. ROY, M. SARKAR and B. CHATTERJEE, Howrah.

Underground corrosion of mild steel (C, 0·28%; Mn, 0·91%ffi Si, 0·08%; P, 0·03% and S, 0·04%) and cast iron (C, 3·1%; Mn, 0·91%; Si, 2·09%; P, 0·24% and S, 0·12%) in four soils from Bangalore (red), Amraoti (black cotton), Bankura (laterite) and Berhampore (alluvial) has been studied by using the electrolytic corrosion cell of Denision-Schwerdt-feger type. The weight losses of corrosion cell electrodes made up of cast iron and mild steel and also the variation of the cell current with time have been measured. An attempt has also been made to correlate the soil corrosivity for mild steel and cast iron in relation to soil characteristics. The combined weight losses of the anodes and cathodes do not seem to show any correlation with the total soluble salt contents of the respective soils nor with the content of any individual component of the water soluble salt. A somewhat better correlation is observed between the combined weight losses of the electrodes of electrolytic corrosion cells on the one hand and the ratio of the total water-soluble anions, expressed as milli-equivalents per 100 gm. of soil, to the water holding capacities of the respective soil, on the other. With both types of electrodes the variation of the cell current with time is found to be dominated largely by chemical and physical characteristics of the soil.

(4) CERAMICS

11. Silicate Engineering : A Study of Iron Colours in Glasses.

H. N. DAS GUPTA and P. Sen, Banaras.

Investigations, aiming at obtaining additional fundamental knowledge relating to colouring effects of ferric iron in glasses at higher temperature, are in progress. The present communication, however, is an introduction to a series of investigations proposed to be undertaken. An attempt has been made at studying the differential thermal analysis characteristics of ferric oxide (250 mesh); comminuted glass of moderately high alkali content; and a mixture of this glass powder with a known p.c. of ferric oxide, and also to correlate if possible, the observed characteristics with available information on iron as a colourant for glass. A conventional type of D.T.A. set was used, the sample holder, however, was made from stainless steel. A heating rate of 5° per minute was maintained with a view to allowing sufficient time for changes, such as sintering; diffusion of ferric oxide; thermal reaction; phase changes, if any; etc., to take place. Endothermic and exothermic peaks have been noted in the curves so obtained.

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From visual examination, the solidified Fe_2O_3 glass looked like a clear transparent mass with a yellowish colour and no trace of bluish or greenish tint could be detected. This fact, and the results of other tests, go to suggest the following :

(i) The rôle of absolute amount of iron on colour development appears to be of secondary importance.

(ii) The conditions inside the Fe_2O_3 glass did not help reduction of ferric oxide, although the glass was sufficiently alkaline. This observation is not in agreement with those of Moore (J. Soc. Glass Tech., 1949, *33,* 265-277), and Moore and Prasad (ibid, 1949, *33,* 336-760).

(iii) The bulk density of the iron containing glass changed, but the change was practically commensurate with the p.c. of ferric iron in it. This indicates that perhaps there has not been loss of any of the ingredients or of oxygen during fusion. Confirmation of this observation by other means is being done.

(iv) From the intensity of yellow colour developed in the glass, it appears that only a portion of the total ferric oxide is acting as a pigment. The prevailing conditions in glass, including duration of heating, were perhaps not favourable for the ferric iron to play the rôle of a net-work—former (Weyl, J. Soc. Glass Tech., 1943, *27,* 265). Indications have, however, been obtained that certain proportion of ferric iron has got access to the interstitial holes of the silica network as ions.

Further work in this line and with other colouring ions of Mn, Cr, Cu, V, Co, Ni, etc., is in progress.

12. Elimination of the Ceramic Reference from the Differential Thermal Analysis of Clays and Other Ceramic Materials. Part I.

D. K. PATWARDHAN, Banaras.

The substitution of the ceramic reference in place of the platinum one in the experimental set up of DTA of ceramic materials causes a reduction in the thermal response of the specimen, generates the BASELINE and makes it drift. The highly active surfaces of the ceramic reference absorb moisture. Such a reference renders the Tr axis nonlinear and makes for a reduction in size of the DTA-curve.

Elimination of the cause of all this confusion and its substitution by platinum, if necessary, are advocated.

13. Comparative Study of Crystal Growth in NephelineSyenite and Felspar Bodies, Part I.

V. C. JOSHI and M. L. MISRA, Banaras.

The formation of mullite crystals in porcelain bodies compounded with Nepheline syenite as addition at the expense of felspar and fabricated by different methods i.e. slip casting, dry pressing and plastic moulding are being investigated.

14. Observations on High Temperature Ceramic yellow strains from Vanadium oxide.

H. N. ROY and V. C. JOSHI, Banaras.

Ceramic yellow stains for low temperature are usually prepared by calcining antimony oxide with lead oxide in an oxidising atmosphere. Antimony oxide alone does not give any colour. It is only when lead is present in the calcine or in the glaze the yellow colour can be produced.

Like antimony oxide, vanadium oxide also does not give a yellow colour alone. Vanadium oxide usually gives a grey colour in ordinary whiteware glazes, maturing at about 1160°C. Hence in order to develop the high temperature yellow ceramic colours, vanadium oxide requires zirconium oxide as a colouring medfa. Along with zirconium oxide, tin oxide, titanium oxide, iron oxide, aluminium oxide and silica can also be used in suitable proportions. The mixtures when calcined at 1200°C still retain some portion of the soluble vanadium oxide which has to be washed after grinding the calcined mixture.

In order to have the vanadium oxide in the combined form which will not be soluble, whiteware glaze and enamel frits were also made using very small proportion of vanadium oxide. Some of the glaze and enamel frits gave good yellow colour.

15. Refractory Materials from Bansi and EMLO (Their Properties and mineralogical nature).

M. L. MISRA, Banaras.

At Bansi in the Uttar Pradesh and at Emlo in Bihar occur two refractory materials of similar properties. These two materials are used in some of the factories in U.P. and Bihar in manufacture of refractory bricks. Their physical, chemical, pyrophysical properties and the results of X-ray study are given. It is suggested that these are not clays. They are probably the residual materials of under-clay calcined due to underground fire of old time coal fields and got mixed up with coal ash. Later on they got compacted due to pressure.

(5) CHEMICAL ENGINEERING

16. Utilisation of the Lime Sludge from the Water Softening Plants.

A. S. BHADURI, Bombay.

There are ten Lime-Soda Water Softening Plants in the Central Railway. The production of lime sludge, the ultimate reaction product of these plants, is about 40 tons a month. At present the sludge is considered as waste product only as there is no use for it either to the Railway or outside traders. In order to find out a suitable use of this sludge, disposal of which is rather a problem, works were taken up in the Central Railway Chemical and Metallurgical Laboratory. The chemical composition of the sludge shows that it contains more than 90% calcium carbonate and magnesium oxide. From this it is concluded that there are several possible uses of the sludge, which are as follows:

(a) Use as flux in the melting of cast iron in the cupola.
(b) Reclamation of the sludge by calcining and its reuse in the water softening plants.
(c) Manufacture of putty.

The details of work carried out on these lines together with the findings are described in this paper.

17. Flotation of Low Grade Uranium Ore from Keruyadungri, S. Bihar.

T. R. MADHAVAN and K. K. MAJUMDAR, Bombay.

An uranium ore containing mainly uraninite in chlorite schist found at Keruyadungri, near Jamshedpur, Bihar, was subjected to flotation on a laboratory scale. The ore assayed 0·055% U_3O_8 and has the following mineralogical composition (in per cent) :—quartz 46, chlorite 37, apatite 3, tourmaline 3, opaque (viz. magnetite, ilmenite, sulphides, uraninite and pyrochlore) 7, others (hematite, limonite and zircon) 4.

The liberation size of uraninite being around 44 μ, it was thought that flotation may work better than gravity methods of beneficiation.

A number of flotation reagents were tried. Fatty acids and soaps were found to give good flotation for U_3O_8 values, in acid and near neutral pulp, oleic acid being the best. The effect of grinding time, conditioning period, pulp density, pH, activators, depressants and frothers has been studied. It is possible to get a U_3O_8 concentrate nearly three times the grade of feed (about 0·15% U_3O_8) with about 80% recovery under the following conditions : Oleic acid as frother-collector, 4·8 kg/tonne, Grinding time : 45 minutes, pulp density : 13% solids, conditioning period : 5 minutes pH about 4·6.

18. Electrolytic Cascade at Kangal.

D. GUPTA and P. G. DESHPANDE, Bombay.

The hydrogen distillation plant for the production of about 14·5 tons of Heavy Water per year will be commissioned very shortly at Nangal. The feed to this distillation plant is 5000 Nm^3 of hydrogen per hour. The deterium content in this hydrogen has been enriched to approximately three times the natural concentration in an Electrolytic Cascade. The principle on which the design of the Cascade is based has been discussed briefly in this paper. The Cascade relations have been developed first assuming ideal conditions. The actual Cascade relations with all the losses have then been developed the different combinations have been considered to find out the most conomic arrangement.

19. Evaluation of Fuller's Earth from Mudh, Rajasthan for decolourization of Lubricating Oils.

M. K. HASNUDDIN SIDDIQUI and D. S. DATAR, Hyderabad.

Raw Mudh earth exhibits capacity for bleaching lubricating oil which is enhanced on acid-activation. Activated earth also shows marked improvement in imparting thermal stability to the bleached oil. The performance of HCl-activated earth is somewhat better than that of H_2SO_4-activated earth.

20. Fuller's earth from Korvi, Mysore, for reclamation of used lubricating oils.

ESHWAR RAJ SAXENA, D. S. DATAR and S. H. ZAHEER, Hyderabad.

Korvi fuller's earth was used successfully for reclamation of used lubricating oils from turbines, transformers and crank cases of trucks and railway and aero engines. The used oils are normally contaminated with oxidation products, dissolved water, acidity, carbon and fuel oil. The reclaimed oil is free from all these impurities.

21. Survey of Chemical Engineering Education in U.S.A.

P. S. LELE, Chandigarh.

A comprehensive survey of chemical engineering education in the U.S.A. was conducted with a view to obtain information suitable for organizing a new department for teaching Chemical Engineering at graduate and undergraduate level. Data was collected by visiting 25 representative universities. Three thousand three hundred and forty-two pages of typed matter, twelve books of solved problems, thirty four books on engineering education, ninety-six text books, one hundred and fifteen catalogues and photographs of chemical engineering laboratories have been collected. Some of the data is analysed. A summary of a diary of personal discussions with a number of Professors about problems connected with chemical engineering education is prepared.

(6) GENERAL

22. Training in Science of Materials.

N. K. PATWARDHAN, Roorkee.

Developments leading to the study of the Science of Materials as a distinct subject has been traced. The impact of solid state physics on the Science of Materials is great; a few examples of the work done on building materials in which certain phenomena are explained on Solid State Theory in Central Building Research Institute, Roorkee are given to indicate the scope of work.

In the end an attempt is made to indicate the places in the developed countries where training is being given on this subject and an appeal is made to our planners to give serious thought to starting such courses in India both at the post-graduate and under-graduate levels at the well established universities and colleges.

23. Time variation of cosmic ray intensity at 15° zenith at Gulmerg.

TAUSIF H. NAQVI and NIAZ AHMAD, Aligarh.

This systematic study of the daily variation of cosmic ray intensity has been done at Gulmerg at 15° zenith angle. Hourly counts have been recorded at 24 azimuth at an interval of 15° at the above noted constant zenith angle. A curve of counting rate versus the hours (Indian standard time) was plotted, the curve shows a maximum between 12 and 14 hours and two minima obtained in 24 hours, the first between 3 and 4 hours and the second between 19 and 20 hours. The maximum variation from the mean intensity was found to be about 1·5% which is in accordance with the results by other workers for vertical intensity. The meteorological effects have not been considered here due to no availability of the upper air. data.

24. Use of retrowings in the landing of space ship.

SHIVA KISHORE, Jullunder.

In the landing of spaceship the problem is to dissipate the kinetic energy. One of the methods is the use of retrojet and the second is the use of air friction. The difficulty in the second method comes from the fact that the spaceship on approaching the planet moves with a velocity nearly equal to the escape velocity and at this velocity it can not be confined within the air as the centrifugal force is twice that of the gravity. The method of a series of dives through the air has been suggested to reduce velocity from the escape velocity to minimum orbital satellite velocity at which the spaceship can be confined in the air. In this paper the use of retrowing has been suggested to keep the spaceship within the air and bring about the landing by one continuous process. It has been suggested that the wings be adjustable from to retro to direct so that all the phases of landing can be covered. The retrowing thrusts the body towards the planet. The maximum thrust has been shown to be equal to the weight of the ship.

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25th ,,	1938,	Calcutta	16	8	0
26th ,,	1939,	Lahore	30	0	0
27th ,,	1940,	Madras	20	0	0
28th ,,	1941,	Banaras	27	6	0
29th ,,	1942,	Baroda	30	4	0
30th ,,	1943,	Calcutta	25	8	0
31st ,,	1944,	Delhi	19	8	0
32nd ,,	1945,	Nagpur	18	0	0
33rd ,,	1946,	Bangalore	18	4	0
34th ,,	1947,	Delhi	21	4	0
35th ,,	1948,	Patna	23	2	0
36th ,,	1949,	Allahabad	23	0	0
37th ,,	1950,	Poona	21	12	0
38th ,,	1951,	Bangalore	23	12	0
39th ,,	1952,	Calcutta	27	12	0
40th ,,	1953,	Lucknow	32	6	0
41st ,,	1954,	Hyderabad (Deccan)	36	0	0
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